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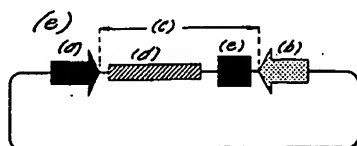
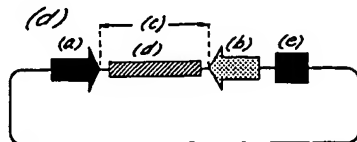
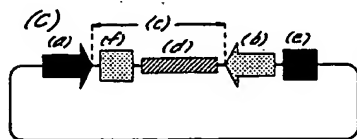
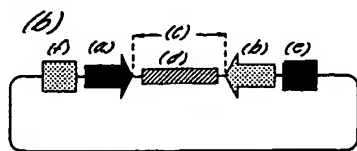
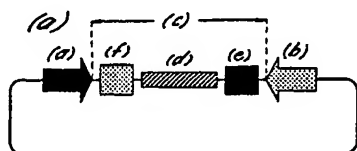
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(54) Title: VECTOR CONSTRUCTS



(57) Abstract: Vector constructs useful in the expression of dou-
ble-stranded RNA. The constructs are particularly useful for ex-
pression of double-stranded RNA in vitro and in vivo.

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VECTOR CONSTRUCTS

Field of the invention

The invention relates to improved vector
5 constructs for use in the expression of double-
stranded RNA, particularly for use in the expression
of double-stranded RNA *in vitro* and *in vivo*.

Background to the invention

10 Since the advent of double-stranded RNA
inhibition (RNAi) as a tool for controlling gene
expression, as described in WO 99/32619 and WO
00/01846, there has been recognised a need for
specialised vectors designed for the production of
15 double-stranded RNA (dsRNA).

Cloning vectors designed to produce high levels
of dsRNA have been previously described by Plaetinck
et al. (WO 00/01846) and Timmons et al. Nature,
395:854 (1998). These vectors generally contain a
20 multiple cloning site (MCS) into which target DNA
fragments can be cloned flanked by two opposable
transcriptional promoters. Essentially, these three
components (Promoter 1, MCS and Promoter 2) make up
the entire system. In the appropriate expression
25 system, the DNA cloned into the MCS may be transcribed
in both directions, leading to the production of two
complementary RNA strands.

A disadvantage of the known systems is that not
only the cloned fragment is transcribed. Read-through
30 of the RNA polymerase will result in transcription of
the entire vector, and this also in both directions.
As only transcription of the cloned DNA fragment will
result in active dsRNA for RNAi purposes,
transcription of the vector part results in useless,

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inefficient RNA. More specifically, 80% of these transcripts can be considered as non-specific and thus non-effective.

The large amounts of non-specific RNA generated by the prior art plasmid and expression systems results in some undesirable side effects. First, in RNAi protocols based on introduction of dsRNA into *C. elegans* via a food organism such as *E. coli* which expresses the dsRNA (see WO 00/01846), large RNA strands are considered to be toxic for the food organism. As a result, high amounts of RNA accumulating in *E. coli* cause a significant part of the population to die. Second, and probably more important, is the reduction of inhibition potential. The presence of large amounts of non-specific dsRNA causes a competitive environment for the specified sequences. The potential of the template-specified dsRNA sequences to inhibit the targeted protein expression in, for instance, *C. elegans* cells is reduced by the presence of these large non-specific regions. Such an inhibition by non-specific dsRNA has also been shown in *Drosophila* by Tushl et al., *Genes & Development* 13:3191-3197 (1999). Not only the potential to inhibit gene expression is affected, but also the amount of specific dsRNA produced is limited. Third, transcription of the vector backbone part, more particularly transcription of the origin of replication and related structures, results in plasmid instability and plasmid reorganisation, leading to reduced production of dsRNA. This relatively low concentration of effective dsRNA in turn leads to inefficient RNAi.

To conclude, the previously described vectors have following shortcomings: they are toxic to the

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feeding organism, a greater proportion of the transcripts produced are non-specific, the inhibitory potential of the dsRNA is reduced by the presence of non-specific regions, a high incidence of plasmid reorganizations and loss of plasmid from the feeding organism. It is therefore an object of the present invention to provide improved vectors for the production of dsRNA which avoid the disadvantages of the prior art vectors.

10 Vectors for use in the *in vitro* synthesis of RNA transcripts, for example the production of RNA probes, have been known and commonly used in the art for some time (see for example F. M. Ausubel et al. (eds.), *Current Protocols in Molecular Biology*, John Wiley & Sons, Inc. (1994); Jendrisak et al, Vectors for in vitro production of RNA copies of either strand of a cloned DNA sequence, US 4,766,072). In standard *in vitro* transcription protocols the problem of read-through transcription of vector sequences is generally avoided by linearizing the transcription vector at restriction site positioned at the 3' end of the desired transcript. However, this solution is not appropriate for *in vivo* transcription or for the production of dsRNA where it is important that the template is transcribed in both directions.

25 The inventors now propose a novel solution to the problems encountered with the prior art vectors for the production of dsRNA, based on the use of transcription terminators. Generally the solution consists of the use of at least one transcription terminator operably linked to at least one promoter, wherein the terminator stops the transcription initiated by the promoter. Any DNA fragment inserted between the 3' end of the promoter and the 5' end of

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the terminator will then be transcribed, without the unwanted transcription of the vector backbone.

Preferentially the vector consists of two promoters and two terminators, as further described below.

5 Therefore, in accordance with a first aspect of the invention there is provided a DNA construct comprising two opposable promoters flanking an inter-promoter region, the construct further comprising at least one transcription terminator positioned
10 transcriptionally downstream of one of the said promoters In particular, the invention provides for:

a DNA construct comprising:

- a) a first promoter and
- b) a second promoter,

15 in which the first and second promoter are in opposite orientation to each other and define:

c) an inter-promoter region positioned downstream of the 3' end of the first promoter and downstream of the 3' end of the second promoter;

20 and which DNA construct further comprises:

d) at least one cloning site positioned in the inter-promoter region; and

e) a first transcription terminator, positioned (as seen from the 3' end of the first promoter)

25 downstream of the first promoter and downstream of the at least one cloning site, wherein the first transcription terminator is operably linked to the first promoter.

The inter-promoter region can also further be
30 defined as: the DNA region between the 3' end of the first promoter and the 3' end of the second promoter, and which is downstream of the first promoter, and which is downstream of the second promoter, and which preferably does not contains the 5' end of the first

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promoter and of the second promoter. The opposable first promoter and second promoter drive expression directional from their 5' ends to their 3' ends starting transcription downstream of their 3' ends, thus providing transcription of both strands of any nucleotide sequence(s) present in the inter-promoter region.

The two promoters present in the DNA construct of the invention may be identical or they may be different and may be of essentially any type. The precise nature of the promoters used in the construct may be dependent on the nature of the expression system in which the construct is expected to function (e.g. prokaryotic vs eukaryotic host cell).

Bacteriophage promoters, for example the T7, T3 and SP6 promoters, are preferred for use in the constructs of the invention, since they provide advantages of high level transcription which is dependent only on binding of the appropriate RNA polymerase. Each of these promoters can independently be chosen. The phage promoters can also function in a wide variety of host systems, i.e. both prokaryotic and eukaryotic hosts, provided that the cognate polymerase is present in the host cell.

The arrangement of two "opposable" promoters flanking an inter-promoter region such that transcription initiation driven by one of the promoters results in transcription of the sense strand of the inter-promoter region and transcription initiation driven by the other promoter results in transcription of the antisense strand of the inter-promoter region is an arrangement well known in the art, for example, in the pGEM7 series of vectors from Promega Corp., Madison WI, USA.

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The DNA constructs of the invention differ from those of the prior art because of the presence of at least one transcription terminator positioned transcriptionally downstream of one of the promoters.

- 5 The transcription terminator may be uni- or bi-directional, the choice of uni- vs bi-directional terminators being influenced by the positioning of the terminator(s) within or outside the inter-promoter region, as explained below. The terminator may be of
- 10 prokaryotic, eukaryotic or phage origin. Bacteriophage terminators, for example T7, T3 and SP6 terminators, are particularly preferred. The only requirement is that the terminator must be capable of causing termination of transcription initiating at the
- 15 promoter relative to which it is transcriptionally downstream. In practice, these means that the promoter and terminator must form a 'functional combination', i.e. the terminator must be functional for the type of RNA polymerase initiating at the
- 20 promoter. By way of example, a eukaryotic RNA pol II promoter and a eukaryotic RNA pol II terminator would generally form a functional combination. The selection of a functional combination is particularly important where bacteriophage promoters and
- 25 terminators are to be used in the constructs of the invention, since the phage promoters and terminators are both polymerase-specific. To form a functional combination both the promoter and the terminator should be specific for the same polymerase, e.g. T7
- 30 promoter and T7 terminator, T3 promoter and T3 terminator etc.

In one embodiment, the DNA construct of the invention may comprise a single transcription terminator, positioned (as seen from the 3' end of the

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first promoter) downstream of the first promoter and downstream of the at least one cloning site, wherein the first transcription terminator is operably linked to the first promoter, wherein the single
5 transcription terminator is positioned in the inter-promoter region

In an alternative arrangement, the DNA construct comprises a single transcription terminator positioned outside of the inter-promoter region. In a still
10 further embodiment, the DNA construct may comprise two transcription terminators, each one of which is positioned transcriptionally downstream of one of the two promoters. In this arrangement, one or both of the terminators may be positioned within the inter-
15 promoter region. These various embodiments of the DNA constructs of the invention will be more fully described below, with reference to the accompanying drawings. The position of a first transcription terminator outside the inter-promoter region may also
20 be further defined as, i.e. such that a first transcription terminator is positioned (as seen from the 3' end of the first promoter) downstream of the first promoter, downstream of the at least one cloning site, and downstream of the 5' end of the second
25 promoter.

The position of a second transcription terminator outside the inter-promoter region may also be further defined as, i.e. such that a second transcription terminator positioned (as seen from the 3' end of the
30 second promoter) downstream of the second promoter, downstream of the at least one cloning site, and downstream of the 5' end of the first promoter.

Moreover, when the terminator is not located in the inter-promoter region, the distance between the 5'

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end of the first promoter and 3' end of the second terminator, or the distance between the 5' end of the second promoter and the 3' end of the first terminator is preferably small, i.e. such that the 3' end of the first transcription terminator is separated from the 5' end of the second promoter by no more than 2000 nucleotides, preferably no more than 1000 nucleotides, more preferably no more than 500 nucleotides, even more preferably no more than 200 nucleotides, especially preferably no more than 100 nucleotides, more especially preferable no more than 50 nucleotides, even more especially preferably no more than 20 nucleotides, particularly preferably no more than 10 nucleotides, more particularly preferably no more than 6 nucleotides.

Furthermore, when the second transcription terminator is located outside of the inter-promoter region, preferably the 3' end of the second transcription terminator is separated from the 5' end of the first promoter by no more than 2000 nucleotides, preferably no more than 1000 nucleotides, more preferably no more than 500 nucleotides, even more preferably no more than 200 nucleotides, especially preferably no more than 100 nucleotides, more especially preferably no more than 50 nucleotides, even more especially preferably no more than 20 nucleotides, particularly preferably no more than 10 nucleotides, more particularly preferably no more than 6 nucleotides

As defined above the term 'inter-promoter region' refers to all of the DNA sequence between the two promoters. As explained above, in certain embodiments of the invention the transcription terminator(s) may be sited within the inter-promoter region. The inter-

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promoter region may, advantageously, comprise a sequence of nucleotides forming a template for dsRNA production. The precise length and nature of this sequence is not material to the invention. The invention further provides DNA constructs in which the inter-promoter region comprises a cloning site. The function of the cloning site is to facilitate insertion of a DNA fragment forming a template for dsRNA production between the two promoters. Thus, the invention provides a series of cloning vectors which are of general use in the construction of template vectors for dsRNA production. Also encompassed within the scope of the invention are vectors derived from the cloning vectors which have a DNA fragment inserted into the cloning site.

The cloning site may further comprise one or more of the following:

- at least one restriction site, (as known in the art), or one or more further restriction sites, e.g. to provide a multiple cloning site (as known in the art),
 - a stuffer DNA, e.g., flanked by at least two restriction sites, such as two *Bst*XI restriction sites, or two *Xcm*I restriction sites,
 - *att*R1 and *att*R2 recombination sites,
 - a *ccdB* nucleotide sequence,
 - a *ccdB* nucleotide further comprising at least one unique blunt-end restriction site, such as a *Srf*I restriction site, and/or
 - a DNA fragment inserted in the at least one cloning site.
- All of the DNA constructs provided by the invention may, advantageously, form part of a replicable cloning vector, such as, for example, a plasmid vector. In addition to the opposable

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promoters, inter-promoter region and transcription terminator(s), the vector 'backbone' may further contain one or more of the general features commonly found in replicable vectors, for example an origin of replication to allow autonomous replication within a host cell and a selective marker, such as an antibiotic resistance gene. The selective marker gene (e.g. the antibiotic resistance gene) may itself contain a promoter and a transcription terminator and it is to be understood that these are completely independent of the promoter and terminator elements required by the invention and are not to be taken into consideration in determining whether a particular vector falls within the scope of the invention.

DNA constructs according to the invention may be easily be constructed from the component sequence elements using standard recombinant techniques well known in the art and described, for example, in F. M. Ausubel et al. (eds.), *Current Protocols in Molecular Biology*, John Wiley & Sons, Inc. (1994), as will be appreciated by one skilled in the art from the following detailed description of the invention and the accompanying Examples.

There follows a detailed description of DNA constructs according to the invention, with reference to the following schematic drawings in which:

Figures 1(a) to 1(e) are schematic representations of several different embodiments of the DNA construct according to the invention illustrating the relative positioning of the promoter and transcription terminator elements.

Figure 2(a) is a schematic representation of a prior

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art vector included for comparison purposes.

Figures 2(b) to 2(e) are schematic representations of several further embodiments of the DNA construct according to the invention illustrating the use of
5 different cloning sites in the inter-promoter region.

Referring to the Drawings, Figure 1(a) schematically illustrates a first DNA construct
10 according to the invention which is a plasmid vector comprising two opposable promoters; a first promoter a) and a second promoter b) flanking an inter-promoter region c), which inter-promoter region is downstream of the 3' of the first promoter, and down
15 stream of the 3' end of the second promoter. The first promoter and the second promoter may be identical or different. This embodiment comprises a first transcription terminator e) and a second transcription terminator f) both of which are
20 positioned within the inter-promoter region. In this embodiment, the first terminator and the second terminator are preferentially uni-directional terminators.

A DNA fragment may be inserted in the at least
25 one cloning site d). Such fragment is subject to transcription directed by the first promoter a) and the second promoter b) (i.e. transcription of both strands), resulting in the generation of two RNA fragments which may combine to double-stranded RNA of
30 the inserted DNA fragment (both *in vitro* and *in vivo*).

Any desired DNA sequence, such as a genomic DNA sequence, or a cDNA sequence or any other coding sequence, may be inserted in the at least one cloning site. Without being limited to any specific

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explanation, it is assumed that when a) and e) form a functional combination, RNA polymerase which initiates transcription at a) will transcribe the inter-promoter region including the at least cloning site and the DNA fragment inserted in the at least cloning site and will be terminated when it reaches e). Similarly, RNA polymerase which initiates transcription at b) will transcribe the inter-promoter region including the at least one cloning site and the DNA fragment inserted in the at least one cloning site and will terminate when it reaches f). The terminators cause the RNA polymerase to pause, stop transcription and fall off the template. This prevents the unlimited transcription of the vector backbone, and reduces the unspecific transcription of non-essential DNA.

The inter-promoter region further comprises a sequence of nucleotides corresponding to a target for double-stranded RNA inhibition. This sequence is designated 'TF' for target fragment. It is this sequence which, when transcribed into dsRNA, will be responsible for specific double-stranded RNA inhibition of a target gene. The target fragment may be formed from a fragment of genomic DNA or cDNA from the target gene. Its precise length and nucleotide sequence are not material to the invention.

In the arrangement shown in Figure 1(a) the two terminators are positioned on either side of the TF within the inter-promoter region. Each of the terminators is positioned transcriptionally downstream of one of the promoters, the first terminator e) is transcriptionally downstream of first promoter a) and the second terminator f) is transcriptionally downstream of the second promoter b). Assuming that a) and e) form a functional combination, as described

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above, RNA polymerase which initiates transcription at a) will transcribe the inter-promoter region up to and including TF and will be terminated when it reaches e). Similarly, RNA polymerase which initiates transcription at b) will transcribe the inter-promoter region up to and including TF on the opposite strand and will terminate when it reaches f). The terminators cause the RNA polymerase to pause, stop transcription and fall off the template. This prevents the unlimited transcription of the vector backbone, and reduces the unspecific transcription of non-essential DNA.

The transcripts generated from this vector may, depending on the precise placement of the terminators in the vector, be almost completely specific dsRNAs corresponding to the TF region. Through the direct placement of the terminator sequences at the downstream end of the TF region on both sides of the inserted DNA fragment, the amount of material transcribed is completely reduced to the template-specified sequences. Therefore, a higher amount of specific dsRNA is obtained. Furthermore the constructs are now also more stable, due to the non-transcription of the vector backbone. The latter characteristic (stability), combined with the now relatively higher specific transcription rate, provides a system adapted to synthesise higher amounts of specific short dsRNA strands. This proportionally higher amount of transcript, resulting in high concentrations of specific dsRNA, enhances the inhibitory effect in RNAi protocols. In RNAi protocols based on expression of dsRNA in a food organism, toxicity for the feeding organisms due to high RNA expression is brought to a minimal level by

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use of this vector.

A specific example of a vector of the type illustrated in Figure 1(a), considered by the inventors to be the optimal arrangement for RNAi applications, is plasmid pGN9 described in the accompanying Examples. The transcriptional terminators used in pGN9 are T7 RNA polymerase specific terminators, since the vector contains two opposable T7 promoters. However, other systems could be used such as an expression system based on the T3 or SP6 promoter, terminator and polymerase or other prokaryotic or eukaryotic promoters and terminators.

Figure 1(b) illustrates schematically a further DNA construct according to the invention which is a plasmid vector comprising two opposable promoters a) and b) flanking an inter-promoter region c). This vector also comprises two transcription terminators e) and f) but in this arrangement the two terminators are positioned outside of the inter-promoter region, in fact the terminator elements now flank the two promoters. The arrangement is such that e) is transcriptionally downstream of a) whilst f) is transcriptionally downstream of b). Here again e) terminates the transcription initiated by a), whilst f) terminates the transcription initiated by promoter b). Placement of the terminators outside of d) allows the use of bi-directional terminators as well as uni-directional terminators, in contrast to the arrangement in Figure 1(a) where uni-directional terminators are preferred because of the placement of the terminators between the promoters. A number of bi-directional terminators which could be used in accordance with the invention are known in the art.

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Generally these are observed to be polymerase non-specific.

The embodiment shown in Figure 1(b) provides essentially the same advantages as that shown in Figure 1(a) over the prior art vectors for dsRNA production. The vector shown in Figure 1(b) will lead to the production of transcripts which are slightly longer, including the promoter regions. This relatively small difference in the length of the transcript and hence the formed dsRNA will not severely affect the efficacy in an RNAi system.

The position of the terminators and promoter in the example as shown in figure 1 (b) are preferably placed at close proximity, such that the 5' end of the promoters are separated from the 3' end of the transcription terminators by no more than 2000 nucleotides, preferably no more than 1000 nucleotides, more preferably no more than 500 nucleotides, even more preferably no more than 200 nucleotides, especially preferably no more than 100 nucleotides, more especially preferably no more than 50 nucleotides, even more especially preferably no more than 20 nucleotides, particularly preferably no more than 10 nucleotides, more particularly preferably no more than 6 nucleotides.

Figure 1(c) illustrates schematically a further DNA construct according to the invention which is a plasmid vector comprising two opposable promoters a) and b) flanking an inter-promoter region c). In this embodiment one terminator (in this case e)) is positioned within the c) and the other (f)) is positioned outside c). Again, e) terminates transcription initiated by a) and f) terminates

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transcription initiated by b). This arrangement may provide a useful solution to the problem of one of the terminators interfering with polymerase activity in the other direction (e.g. f) interferes with b) initiated transcription). This vector essentially provides the same advantages as the vector variations shown in Figure 1(a) and Figure 1(b) over the prior art. The relatively small difference in the length of the transcript due to the transcription of one of the promoters will not significantly affect the efficacy in RNAi systems. This more particularly the case when the terminator that is located outside of the inter-promoter region c) is at close proximity of the promoter, as defined above.

Figures 1(d) and 1(e) illustrate schematically two further DNA constructs according to the invention which are both plasmid vectors comprising two opposable promoters a) and b) flanking an inter-promoter region c). These embodiments comprise a single terminator only. In the arrangement shown in Figure 1(d) a single terminator e) which terminates transcription from a) is placed outside of c). The placement of the terminator outside of the IPR allows the use of both a bi-directional terminator or a uni-directional terminator in this system. In the embodiment shown in Figure 1(d) e) is placed within the c). a) should therefore preferably be a uni-directional terminator.

Further embodiments of the DNA construct according to the invention are illustrated schematically in Figures 2(b) to 2(e).

These embodiments are all plasmid cloning vectors, based upon the optimal arrangement of promoters and terminators shown in Figure 1(a), and

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described above, containing cloning sites to facilitate the insertion of a DNA fragment into the at least on cloning site.

These embodiments are all plasmid cloning
5 vectors, based upon the optimal arrangement of promoters and terminators shown in Figure 1(a), containing cloning sites to facilitate the insertion of a target DNA fragment into the inter-promoter region.

10 Figure 2(a), which is a schematic representation of a prior art cloning vector, is included for comparison purposes. This vector comprises two opposable promoters a) and b), which may be identical or different, flanking a multi-cloning site (MCS).

15 Figure 2(b) illustrates a first type of plasmid cloning vector according to the invention. The vector contains a first opposable promoters a) and a second opposable promoter b) flanking an inter-promoter region. The inter-promoter region can further be
20 defined as: the DNA region between the 3' end of the first promoter and the 3' end of the second promoter, and which is downstream of the first promoter, and which is downstream of the second promoter, and which preferably does not contains the 5' end of the first
25 promoter and of the second promoter. The inter-promoter promoter region further comprises terminators e) and f) flanking a multi-cloning site MCS. The MCS comprises at least one individual restriction sites, an preferably more than one
30 restriction site as known in the art, any of which may be used for insertion of a DNA fragment.

Figure 2(c) illustrates a further type of plasmid cloning vector according to the invention. This vector again contains opposable promoters a) and b)

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flanking an inter-promoter region comprising terminators e) and f). In this embodiment, a) and b) flank a cloning site which is adapted for facilitated cloning of PCR fragments, comprising a stuffer DNA
5 flanked by two identical restriction sites, in this case BstXI sites. The specific sequence of the stuffer DNA is not essential, provided that said stuffer DNA does not interfere with the desired effect and/or the desired activity of the DNA constructs of the
10 invention. A specific example of a vector according to this aspect of the invention described herein is plasmid pGN29.

The cloning of PCR products using BstXI recognition sites and BstXI adaptors is generally
15 known in the art. The BstXI adaptors are commercially obtained, such as from Invitrogen (Groningen, the Netherlands). These adaptors are non-palindromic adaptors designed for easier and efficient cloning of PCR products into vectors. These use of these adaptors
20 reduces the concatemerization of adaptors or insert DNA by having non-complementary (CACA) overhangs. The stuffer DNA is included merely to allow easy differentiation between BstXI cut and uncut vector on the basis of size. Its precise length and sequence
25 are not of importance.

Figure 2(d) illustrates a further type of plasmid cloning vector according to the invention. This vector again contains opposable promoters a) and b) flanking an inter-promoter region comprising
30 terminators e) and f). In this embodiment, a) and b) flank a cloning site which facilitates "High Throughput" cloning based on homologous recombination rather than restriction enzyme digestion and ligation. As shown schematically in Figure 2(d), the cloning

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site comprises *attR1* and *attR2* recombination sites from bacteriophage lambda flanking a gene which is lethal to *E. coli*, in this case the *ccdB* gene.

An alternative cloning method of DNA fragments
5 into this vector, (not shown in Figure 2 (d)), consists of a variant of this vector, wherein the *ccdB* DNA sequence further comprises at least one unique restriction site, preferably the at least unique restriction site is a blunt-end restriction site, such
10 as a *SrfI* restriction site. Insertion of a DNA fragment in the at least unique restriction, results in inactivation of the *ccdB* gene, and hence in inactivation of the lethal *ccdB* gene.

A further variant of a vector is shown in Figure
15 2(d) in which the *attR1* and the *attE2* are not present. Such a vector comprises an at least one cloning site, said at least one cloning site consisting of a *ccdB* sequence, said *ccdB* sequence further comprising at least one unique restriction site, preferably the at
20 least unique restriction site is a blunt-end restriction site, such as a *SrfI* restriction site. Insertion of a DNA fragment in the at least unique restriction, results in inactivation of the *ccdB* gene, and hence in inactivation of the lethal *ccdB* gene.

25 These cloning sites comprising the *ccdB* nucleotide sequence and/or the *attR* sites (*R1* and/or *R2*) are derived from the Gateway™ cloning system commercially available from Life Technologies, Inc. The Gateway™ cloning system has been extensively
30 described by Hartley et al. in WO 96/40724 (PCT/US96/10082). A specific example of a vector according to this aspect of the invention described herein is pGN39.

- 20 -

Figure 2(e) and 2(f) illustrate a still further type of plasmid cloning vector according to the invention. This vector again contains opposable promoters a) and b) flanking an inter-promoter region c) comprising terminators e) and f). In the embodiment shown in Figure 2(e), e) and f) flank a cloning site which facilitates "high throughput" cloning of PCR products by TATM cloning. This cloning site comprises a stuffer DNA flanked by two identical restriction sites for an enzyme which generates overhanging T nucleotides. In this case the restriction sites are XcmI sites, but other sites which are cleaved to generate overhanging T nucleotides could be used with equivalent effect. The overhanging T nucleotides facilitate cloning of PCR products which have a overhanging A nucleotide. This principle is known as TATM cloning. The cut vector with overhanging T nucleotides can be "topomerized" to generate a cloning vector of the type shown schematically in Figure 2(f), by linking the enzyme topoisomerase to the overhanging T nucleotides. The resulting vector also facilitates the cloning of PCR products by the principle known as TOPOTM cloning.

Both the TOPOTM and TATM cloning systems, although not for the vectors described in this invention, are commercially available from Invitrogen. The TOPOTM cloning system has extensively been described by Shuman in WO 96/19497 (PCT/US95/16099). The TATM cloning system has extensively been described by Hernstadt et al. in WO 92/06189 (PCT/US91/07147).

It will be readily appreciated by the skilled reader that whilst Figures 2(b)-2(f) illustrate the inclusion of different cloning sites into a vector of the type illustrated in Figure 1(a), these cloning

- 21 -

sites could be included into any of the DNA constructs of the invention, including those illustrated schematically in Figures 1(b) to 1(e)

5 Application of the DNA constructs of the invention in RNAi technology.

As aforementioned, a major application of the DNA constructs/vectors of the invention is in the production of double stranded RNA for use in RNAi
10 technology. In particular, the constructs are useful in *in vivo* RNAi protocols in the nematode worm *C. elegans*.

In *C. elegans*, RNAi has traditionally been performed by injection dsRNA into the worm. Fire et
15 al. describes these methods extensively in International Application No. WO 99/32619. In short, both strands of RNA are produced *in vitro* using commercially available *in vitro* transcription kits. Both strands of RNA are allowed to form dsRNA, after
20 which the dsRNA is injected into *C. elegans*. The new vector system developed by the present inventors is a drastic improvement on this traditional method. First, the RNA can be produced in one step, for instance by using two identical promoters such as
25 in the vector pGN9. Second, and more important, due to the presence of terminators the transcripts, and hence the formed dsRNA, will be more specific as only the cloned target fragment will be transcribed. This will result in a more efficient RNAi.

30 A further method to perform RNAi experiments in *C. elegans* has been described by Plaetinck et al. in WO 00/01846. In this method *C. elegans* worms are fed with bacteria which produce dsRNA. The dsRNA passes the gut barrier of the worm and induces the same RNAi

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as if the dsRNA has been injected. For these experiments, the preferred *E. coli* strain is HT115 (DE3), and the preferred *C. elegans* strain is nuc-1;gun-1. The improved vectors provided by the invention also improve the efficiency of RNAi in this method, as shown in the example below, as only effective dsRNA is produced.

Another method to perform RNAi has also been described by Plaetinck et al. in WO 00/01846. In short, this method is based on the production of dsRNA in the worm itself. This can be done by using worm promoters in the described vectors, or by using a transgenic worm expressing a polymerase specific for non-*C. elegans* promoters present in the vector, such that this polymerase drives transcription of the dsRNA. The promoters will preferentially be selected from the known bacteriophage RNA promoters, such as T7 or T3 or SP6 RNA promoters, which provide the advantage of a high level of transcription dependent only on the binding of the cognate polymerase.

Plasmid vector DNA can be introduced into the worm by several methods. First, the DNA can be introduced by the traditional injection method (Methods in Cell Biology, Vol 48, *C. elegans* Modern Biological Analysis of an organism, ed. by Epstein and Shakes). Second, the DNA can be introduced by DNA feeding. As has been shown by Plaetinck et al. in WO 00/01846, plasmid DNA can be introduced into the worm by feeding the worm with an *E. coli* strain that harbors the plasmid. Preferentially the *E. coli* strain is OP50, or MC1061 or HT115 (DE3) but any other strain would suit for this purpose. The *C. elegans* strain is preferentially a nuc-1 mutant strain or a nuc-1; gun-1 strain. The plasmid DNA from the *E. coli*

- 23 -

passes the gut barrier and is introduced into the nematode, resulting in the expression of dsRNA. As with the other RNAi methods described above, the use of the new vector system will enhance the RNAi by the
5 production of only specific dsRNA.

The invention will be further understood with reference to the following experimental Examples, together with the following additional Figures in
10 which:

Figure 3 is a representation (plasmid map) of pGN1.

Figure 4 is a representation (plasmid map) of pGN9.
15

Figure 5 illustrates the nucleotide sequence of a fragment of plasmid pGN1, annotated to show the positions of the opposable T7 promoters.

20 Figure 6 depicts the nucleotide sequence of the T7 transcription terminator.

Figure 7 illustrates the sequences of oligonucleotides oGN27, oGN28, oGN29 and
25 oGN30 used to insert T7 transcription terminators into pGN1. The positions of the T7 pol terminator sequences and of various restriction sites are marked.

30 Figure 8 illustrates the nucleotide sequence of a fragment of plasmid pGN9, annotated to show the positions of the opposable T7 promoters and the T7 transcription terminators.

- 24 -

Figure 9 (a) is a representation (plasmid map) of pGN29; (b) is a representation (plasmid map) of pGN39; (c) is a representation (plasmid map) of the plasmid TopoRNAi.

.5

Figure 10 shows the complete nucleotide sequence of plasmid pGN9.

Figure 11 shows the complete nucleotide sequence of plasmid pGN29.

10

Figure 12 shows the complete nucleotide sequence of plasmid pGN39.

15 Figure 13 shows the complete nucleotide sequence of plasmid TopoRNAi.

Figure 14 shows the complete sequence of plasmid pGN49A.

20

Figure 15 shows the complete sequence of plasmid pGN59A.

Figure 16 is a representation (plasmid map) of pGN49A.

25

Figure 17 is a representation (plasmid map) of pGN59A.

30

Example 1-Vector construction.

The starting point for construction of the
5 vectors exemplified herein was plasmid pGN1. This
plasmid, described in the applicant's co-pending
International Application No. WO 00/01846, contains
two opposable T7 promoters flanking a multi-cloning
site.

10 Vector construction was carried out according to
standard molecular biology techniques known in the art
and described, for example, in F. M. Ausubel et al.
(eds.), *Current Protocols in Molecular Biology*, John
Wiley & Sons, Inc. (1994).

15

1) Construction of pGN9

pGN1 was first digested with restriction enzymes
EcoRI and KpnI. Oligonucleotides oGN27 and oGN28
(Figure 7) were annealed to generate a double stranded
20 fragment which was then ligated into the EcoRI/KpnI
cut vector. The resulting plasmid was re-digested
with XbaI and HindIII. Oligonucleotides oGN29 and
oGN30 were annealed to generate a double-stranded
fragment which was then annealed into the XbaI/HindIII
25 cut vector. The resulting vector was designated pGN9
(Figures 4 and 10).

2) Construction of further cloning vectors

pGN29 (Figure 9(a); Figure 11) was generated by
30 replacing the MCS in pGN9 with a stuffer DNA flanked
by BstXI sites. BstXI adapters are commercially
available from Invitrogen (Groningen, the
Netherlands).

- 26 -

pGN39 (Figure 9 (b); Figure 12) generated by following steps; pGN29 was digested with BstXI. BstXI adapters (Invitrogen, Groningen, The Netherlands) were ligated
5 to Cassette A provided by the GATEWAY™ system (Life Technologies, Inc.). Cassette A contains attR1, CmR, CcdA, CcdB, attR2. The Cassette A with the adapters were then ligated into the digested pGN29, resulting in pGN39A. pGN39A contains a unique SrfI site in the
10 ccdB gene.

The TopoRNAi vector (figure 9 (c); figure 13) was generated in the following way; pGN29 was digested with BstXI. Using PCR with the primers oGN103 and
15 oGN104 and template pCDM8 (Invitrogen, Groningen, The Netherlands), a stuffer was generated which includes XcmI sites. Onto the PCR product, BstXI adapters were ligated, and the resulting ligation product was ligated in the BstXI digested pGN29 vector resulting
20 in the TopoRNAi vector.

oGN103: 5' TACCAAGGCTAGCATGGTTTATCACTGATAAGTTGG 3'

oGN104: 5' TACCAAGGCTAGCATGGGCCTGCCTGAAGGCTGC 3'

25 PGN49A was constructed to insert an additional unique non-blunt restriction site and to delete the CmR gene pGN39. Overlap PCR was used. A first PCR was performed with primers oGN126 and oGN127 and PGN39A as template. Using primers oGN128 and oGN129 and the same template a
30 second fragment was generated. Overlap PCR using the resulting fragments and primers oGN126P and oGN129P resulted in a final PCR product. To this final PCR

- 27 -

product, BstXI adapters were ligated, and the ligation product was ligated into pGN29 digested with BstXI. The resulting vector was designated pGN49A.

- 5 A control vector was generated to test the efficiency of the pGN49A cloning vector, such vector should contain the T7 promoters, but not the T7 terminators. For this, the XbaI insert of pGN49A was isolated and cloned in pGN1 digested with the same restriction
10 enzyme. The resulting vector was designated pGN59A.

oGN126 pGATCTGGATCCGGCTTACTAAAAGCCAGATAACAGTATGC

oGN127 GGAGACTTTATCGCTTAAGAGACGTGCACTGGCCAGGGGGATCACC

oGN128:

- 15 CCAGTGCACGTCTCTTAAGCGATAAAGTCTCCCGTGAACCTTACCCGGTGG

oGN129 pGCTGTGTATAAGGGAGCCTGACATTTATATTCCCCAG

Example 2-To illustrate the usefulness of the improved vectors in RNA.

- 20 This experiment was designed to illustrate the improved efficiency of the improved vectors of this invention in double-stranded RNA inhibition, as compared to the vectors known from the prior art. A significant increase on the efficacy of the system
25 could be expected, as more effective dsRNA was produced and hence RNAi performed better. The experimental system for this proof of concept experiment was to measure *C. elegans* rescue at 25°C in nuc-1 / pha-1(e2123)ts *C. elegans* mutants by RNAi of
30 sup35 using dsRNA feeding of pGN-2 (-terminator) and pGN-12 (+ terminator), with PGN-1 (empty vector) as a control and dilutor. The pha-1 ts / sup-35 mutation has extensively been described by Schnabel in WO

99/49066.

The *nuc-1* mutation in *C. elegans* provides for a *C. elegans* strain exhibiting better uptake abilities, such as the uptake of the dsRNA complexes than wild type *C. elegans*. This mutant is deleted in the major DNase enzymes, and inventors have proven in earlier co-pending applications that this *C. elegans* strain results in enhanced RNAi by feeding the nematode with dsRNAs.

The *pha-1(e2123)ts* mutation provides a mutant *C. elegans* strain with a phenotype of survival at 15°C and lethality at 25°C. This lethality is suppressible by the inhibition of *sup-35* expression. RNAi of *sup-35* should thus facilitate the rescue of *pha-1(e2123)ts* at 25°C. The vectors of the present invention, when expressing dsRNA from *sup-35*, should increase the efficacy of *sup-35* RNAi in rescuing *pha-1(e2123)ts* mutants at 25°C, compared to vectors that do not contain the terminators.

Vector pGN1 was used as empty vector. Vector pGN2 (-terminator) is a vector harboring *sup-35* DNA and expressing *sup-35* dsRNA when introduced in the appropriate host, the vector has no transcriptional terminators inserted. Vector pGN12 (+ terminator) is a vector as described above, containing the transcriptional terminators, and hence resulting in improved dsRNA production when introduced into an appropriate host. Thus, this vector has two unidirectional transcriptional terminators, both placed inside of the inter-promoter region, and flanking the *sup-35* fragment. Use of the latter

- 29 -

vector was expected to increase the efficacy of the system, here meaning a better rescue (survival) of pha-1(e2123)ts mutants at 25°C.

5 Experimental conditions

12-well micro-titer plates were filled with approximately 2 ml of NGM agar per well.

(1 liter of NGM agar: 15g Agar, 1g peptone, 3g NaCl, 1ml cholesterol solution (5 mg/ml in EtOH), with
10 sterile addition after autoclaving of 9.5 ml 0.1M CaCl₂, 9.5 ml 0.1 ml MgSO₄, 25 ml 1M KH₂PO₄/K₂HPO₄ buffer pH 6, Ampicillin (100 µg/l), 5ml 0,1M IPTG and 5 ml nystatin solution (dissolved 10 mg/ml in 1:1 EtOH:CH₃COONH₄ 7.5 M)

15

The dried plates were spotted with approximately 50 µl of an overnight culture of bacteria HT115 (DE3) (Fire A, Carnegie Institution, Baltimore, MD) transformed with the plasmids. Individual nematodes at the L4
20 growth stage were then placed in single wells at day 1. In each well 1 nematode (P1). At day two, the P1 nematodes were placed to a new well and left to incubate for a day. The same procedure was repeated at day 3. All plates were further incubated at 25°C to
25 allow offspring to be formed. Sup35 RNAi induced survival (rescue) was measured by counting the offspring.

Results

30 RNAi experiment in *C. elegans* nuc-1/pha-1(e2123)ts mutants by feeding with *E. coli* expressing sup-35 dsRNA.

- 30 -

Set up:

pGN1 as control

pGN2 (sup 35 - Term.)

pGN12 (sup 35 + Term.)

5

pGN2 + pGN1 dilutions 1/2, 1/4, 1/8, 1/16, 1/32

pGN12 + pGN1 dilutions 1/2, 1/4, 1/8, 1/16, 1/32

10 Conditions:

Incubation temperature 25°C

Readout:

Count offspring (adult hermaphrodites)

pGN1 (control)

Day 1	0	0	0	0
Day 2	0	0	0	0
Day 3	0	0	0	0

pGN2 (undiluted)

Day 1	12	4	48	32
Day 2	24	23	80	85
Day 3	5	0	9	16

pGN12 (undiluted)

Day 1	16	29	37	14
Day 2	27	22	57	2
Day 3	1	2	4	1

pGN 2+1, 1/2 dilution

Day 1	0	7	0	2
Day 2	9	10	0	3
Day 3	0	2	0	0

pGN 12+1, 1/2 dilution

Day 1	22	28	103	61
Day 2	36	45	53	40
Day 3	3	3	25	1

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pGN 2+1, 1/4 dilution

Day 1	28	23	0	0
Day 2	6	3	0	0
Day 3	0	0	0	0

pGN 12+1, 1/4 dilution

Day 1	*	6	36	5
Day 2		24	55	3
Day 3				

pGN 2+1, 1/8 dilution

Day 1	0	0	4	0
Day 2	0	0	11	0
Day 3	0	0	0	0

pGN 12+1, 1/8 dilution

Day 1	31	12	16	38
Day 2	4	5	37	4
Day 3	0	0	2	1

pGN 2+1, 1/16 dilution

Day 1	0	0	0	0
Day 2	0	0	0	1 little
Day 3	0	0	0	0

pGN 12+1, 1/16 dilution

Day 1	1	0	0	0
Day 2	2	0	0	1
Day 3	0	1	1	1

pGN 2+1, 1/32 dilution

Day 1	0	0	0	0
Day 2	0	0	0	0
Day 3	0	0	0	0

pGN 12+1, 1/32 dilution

Day 1	0	0	1	0
Day 2	0	L2	3	0
Day 3	2	0	L3- L4	0

5

* mother died

Conclusions

As expected, worms fed by bacteria harboring pGN1, did not result in the viable offspring, due to the lethal effect of the pha-1 mutation at this temperature.

- 5 Feeding the nematodes with *E. coli* harboring pGN2 or pGN12 both result in viable offspring. This is due to the feeding of the worm with dsRNA from sup-35. The remarkable difference between the two feeding experiments can be seen in the dilution series. When
10 diluting the bacteria harboring pGN2 with bacteria harboring pGN1, the number of offspring diminishes drastically, even at a low dilution of one to two. This dilution series indicates that high levels of dsRNA are needed to have a proper RNAi induction. In
15 the feeding experiment with bacteria harboring pGN12, significant offspring is still observed at a dilution of one to eight. This indicates that in the bacteria harboring pGN12, much more effective dsRNA is formed. This experiment clearly shows that the addition of
20 terminator sequences in vectors to express dsRNA as described above provide a significant advantage in the generation of RNAi.

25 Example 3: Comparison of RNAi efficiency of vectors with and without T7 terminators(pGN49 vs pGN59)

- Three different genes have been cloned in the vectors pGN49A and pGN59A. The cloning was performed by amplifying the gene fragments with PfuI DNA polymerase
30 producing blunt ends, facilitating cloning in these vectors. These PCR fragments were cloned into the vectors digested with SrfI. Correct fragment insertion of the clones was checked by PCR. The fragments are chosen such that ds expression and RNAi results in a

- 33 -

lethal phenotype of the offspring. This procedure allows to compare fast and easy the efficiency of the two vectors pGN49 and pGN59 in RNAi.

plasmid	Gene (acedb)	Vector backbone
pGW5	B0511.8	pGN49A
pGW9	C01G8.7	pGN49A
pGW11	C47B2.3	pGN49A
pGW17	B0511.8	pGN59A
pGW21	C01G8.7	pGN59A
pGW23	C47B2.3	pGN59A

All the plasmids (pGW-series) are transformed in *E. coli* AB301-105 (DE3) bacteria by standard methodology. The bacteria are then grown in LB/amp at 37°C for 14-18h.

25 These cultures were centrifuged and the bacterial pellet dissolved in S-complete buffer containing 1mM IPTG and 100 µg/µl ampiciline.

In 96 well plates containing 100 µl S-complete (containing 1 mM IPTG and 100 µg/µl ampiciline final concentration) and 10 µl of bacteria solution, 3

30 nematodes were added at each well, the nematodes were at the L1 growth stage.

The plates were incubated at 25°C for 5-6 days. Each

- 34 -

day the plates are inspected for development of the larvae and the production of F1 offspring.

5 Results

The RNAi was performed in eight-fold for each constructed plasmid. The results show that when T7 terminators are inserted into the vector backbone, the expected phenotype gives a 100% occurrence. When T7 terminators are not used the reproducibility can decrease up to 50%. As in the previous experiment, the results show that the addition of terminators significantly enhances RNAi performance.

DNA						
fragment	B0511.8	B0511.8	C01G8.7	C01G8.7	C47B2.3	C47B2.3
Vector	pGN49A	pGN59A	PGN49A	pGN59A	pGN49A	pGN59A
Resulting						
plasmid	PGW5	PGW17	PGW9	PGW21	PGW11	PGW23
Percentage						
lethal	100	75	100	87.5	100	50
Percentage						
offspring	0	25	0	12.5	0	50

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PCR fragment generated by the primers oGN103 and
oGN104 on template pCDM8

TACCAAGGCT AGCATGGTTT ATCACTGATA AGTTGG
5 ATAAGTTGGT GGACATATTA TGTTTATCAG TGATAAAGTG TCAAGCATGA
CAAAGTTGCA GCCGAATACA GTGATCCGTG CCGGCCCTGG ACTGTTGAAC
GAGGTCGGCG TAGACGGTCT GACGACACGC AAAGTGGCGG AACGGTTGGG
GGTGCAGCAG CCGGCGCTTT ACTGGCACTT CAGGAACAAG CGGGCGCTGC
TCGACGCACT GGCCGAAGCC ATGCTGGCGG AGAATCATAC GCTTCGGTGC
10 CGAGAGCCGA CGACGACTGG CGCTCATTTT TGATCGGGAA TCCCGCAGCT
TCAGGCAGGC CCATGCTAGC CTTGGTACCA GCACAATGG

Overlap PCR Fragment, which was used to generate
15 pGN49A

gatctggatccggcttactaaaagccagataacagtatgcgtatcttgcgcgctg
atctttgcggtataagaatatatactgatatgtatacccgaagtatgtcaaaaa
gaggtgtgctatgaagcagcgtattacagtgacagttgacagcgacagctatca
20 gttgctcaaggcatatatgatgtcaatctccggtctggttaagcacaacctg
cagaatgaagcccgtcgtctgcgtgccgaacgctggaaagcggaaaatcaggaa
gggatggctgaggtcgcccggtttattgaaatgaacggctcttttgctgacgag
aacagggactggtgaaatgcagtttaagggtttacacctataaaagagagagccg
ttatcgtctgtttgtggatgtacagagtgatattattgacacgcccgggcga
25 cggatggtgatccccctggccagtgcacgtctcttaagcgataaagtctccc
gtgaactttaccgggtggtgcatatcggggatgaaagctggcgcatgatgac
caccgatatggccagtgtgccggtctccggttatcggggaagaagtggctgat
ctcagccaccgcgaaaatgacatcaaaaacgccattaacctgatgttctggg
gaatataaatgtcaggctcccttatacacagc

30

Claims:

1. A DNA construct comprising:
 - a) a first promoter and
 - 5 b) a second promoter,
in which the first and second promoter are in
opposite orientation to each other and define:
 - c) an inter-promoter region positioned downstream of
the 3' end of the first promoter and downstream of
10 the 3' end of the second promoter;
and which DNA construct further comprises:
 - d) at least one cloning site positioned in the inter-
promoter region; and
 - e) a first transcription terminator, positioned (as
15 seen from the 3' end of the first promoter)
downstream of the first promoter and downstream of
the at least one cloning site, wherein the first
transcription terminator is operably linked to the
first promoter.
- 20 2. A DNA construct according to claim 1, further
comprising:
 - f) a second transcription terminator positioned (as
seen from the 3' end of the second promoter)
25 downstream of the second promoter and downstream of
the at least one cloning site.
wherein the second transcription terminator is
operably linked to the second promoter.
- 30 3. A DNA construct according to claim 1 or 2, in
which the first transcription terminator is
positioned in the inter-promoter region.

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4. A DNA construct according to claim 1 or 2, in which the first transcription terminator is positioned (as seen from the 3' end of the first promoter) downstream of the first promoter,
5 downstream of the at least one cloning site, and downstream of the 5' end of the second promoter.
5. A DNA construct according to any one of claims 2,
10 3 or 4, in which the second transcription terminator is positioned in the inter-promoter region.
6. A DNA construct according to any of claims 2, 3
15 or 4 in which the second transcription terminator is positioned (as seen from the 3' end of the second promoter) downstream of the second promoter, downstream of the at least one cloning site, and downstream of the 5' end of the first
20 promoter.
7. A DNA construct according to any one of claims 4,
5 or 6, in which the 3' end of the first transcription terminator is separated from the 5'
25 end of the second promoter by no more than 2000 nucleotides, preferably no more than 1000 nucleotides, more preferably no more than 500 nucleotides, even more preferably no more than 200 nucleotides, especially preferably no more
30 than 100 nucleotides, more especially preferably no more than 50 nucleotides, even more especially preferably no more than 20 nucleotides, particularly preferably no more than 10

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nucleotides, more particularly preferably no more than 6 nucleotides.

8. A DNA construct according to any one of claims 6
5 or 7, in which the 3' end of the second transcription terminator is separated from the 5' end of the first promoter by no more than 2000 nucleotides, preferably no more than 1000 nucleotides, more preferably no more than 500
10 nucleotides, even more preferably no more than 200 nucleotides, especially preferably no more than 100 nucleotides, more especially preferably no more than 50 nucleotides, even more especially preferably no more than 20 nucleotides,
15 particularly preferably no more than 10 nucleotides, more particularly preferably no more than 6 nucleotides.
9. A construct according to any one of the preceding
20 claims wherein the first and the second promoter are identical.
10. A DNA construct according to any one of the
claims 1 to 7 wherein the first and the second
25 promoter are non-identical.
11. A DNA construct according to claims 8 or 9
wherein the first promoter and the second
30 promoter are independently chosen from T7, T3 or SP6 promoters.
12. A construct according to any one of the preceding
claims wherein the cloning site comprises at

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least one restriction site.

13. A DNA according to claim 11 wherein the cloning
site comprises at least two restriction sites
5 flanking a sequence of stuffer DNA.
14. A DNA construct according to claim 12 wherein the
at least two restriction sites are identical.
- 10 15. A DNA construct according to any one of the claim
12 to 13 wherein the at least one restriction
site or the at least two restriction sites
restriction sites are *BstXI* sites.
- 15 16. A DNA construct according to any one of the
claims 12 to 13 wherein the restriction sites are
XcmI sites.
17. A DNA construct according to any one of the
20 preceding claims wherein the cloning site further
comprises *attR1* and *attR2* recombination
sequences.
18. A DNA construct according to any one of the
25 preceding claims wherein the cloning site further
comprises a *ccdB* nucleotide sequence.
19. A DNA construct according to claim 17 wherein the
ccdB nucleotide sequence further comprises at
30 least one unique restriction site.
20. A DNA construct according to claim 18 wherein the
at least one unique restriction site are blunt-
end restriction sites.

- 40 -

21. A DNA construct according to claim 19 wherein the blunt-end restriction sites are *SrfI* sites.
- 5 22. A DNA according to any one of the preceding claims which further comprises:
g) a DNA fragment inserted in the at least one cloning site.
- 10 23. A DNA construct according to any one of the preceding claims which is a plasmid or vector.
24. A plasmid or vector as claimed in claim 23 having the nucleotide sequence illustrated in Figure 10,
15 Figure 11, Figure 12, Figure 13, Figure 14, or Figure 15.
25. Use of the DNA construct according to any one of the preceding claims for the production of
20 double-stranded RNA for RNA inhibition.
26. A bacterial strain harbouring the DNA construct according to any one of the preceding claims.
- 25 27. A bacterial strain according to claim 26, wherein said bacteria strain is an *E. coli* strain.
28. Use of the bacterial strain according to claims 26 or 27 for the production of double-stranded
30 RNA for RNA inhibition.

FIG. 1(a)

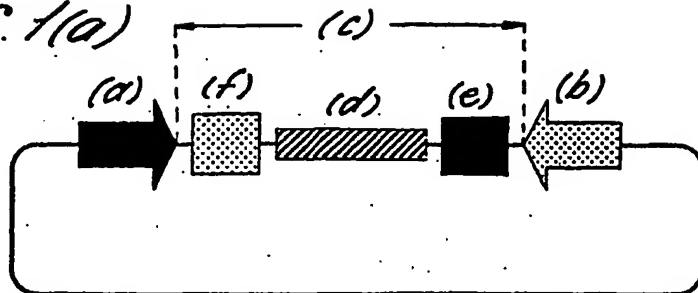


FIG. 1(b)

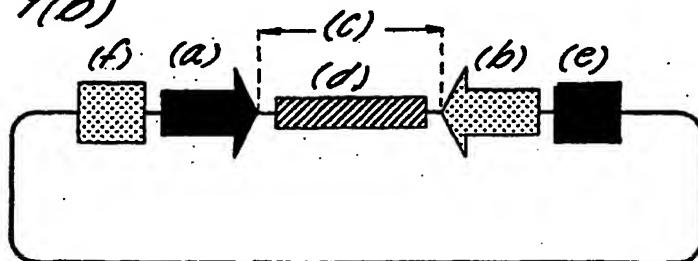
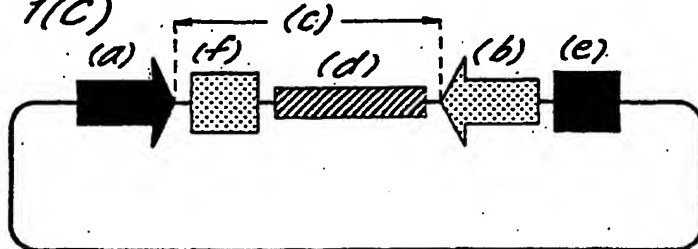


FIG. 1(c)



(a): promoter 1
(b): promoter 2

(e): Terminator 1
(f): Terminator 2

FIG. 1(d)

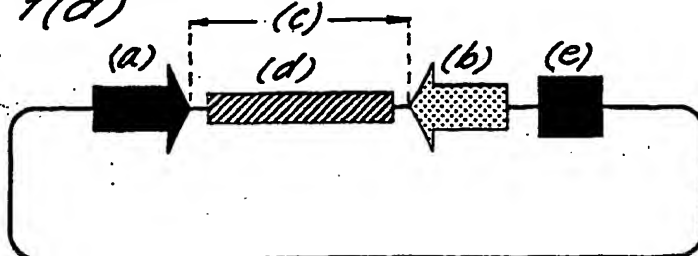


FIG. 1(e)

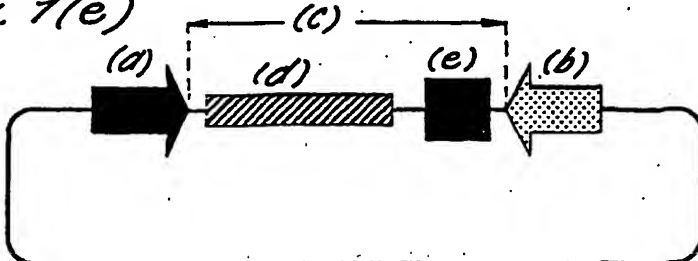


FIG. 2(a)

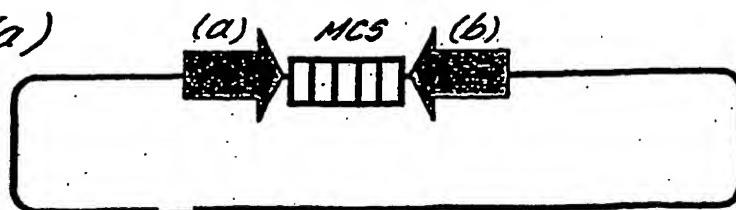


FIG. 2(b)

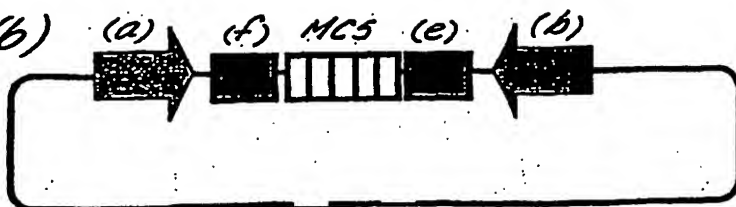


FIG. 2(c)

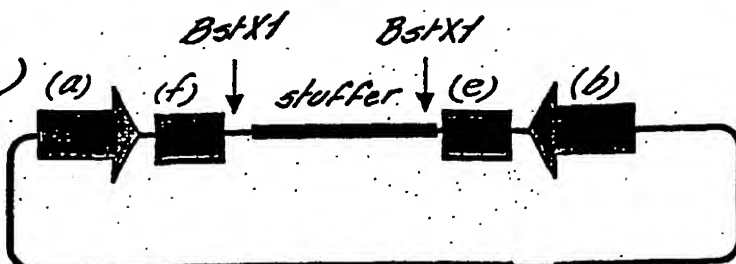


FIG. 2(d)

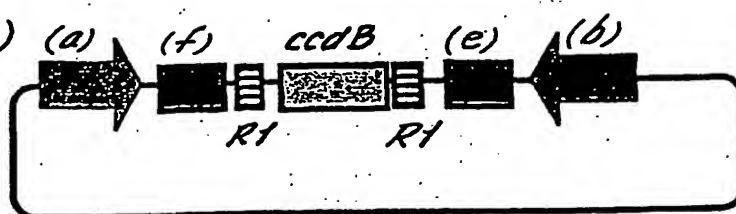


FIG. 2(e)

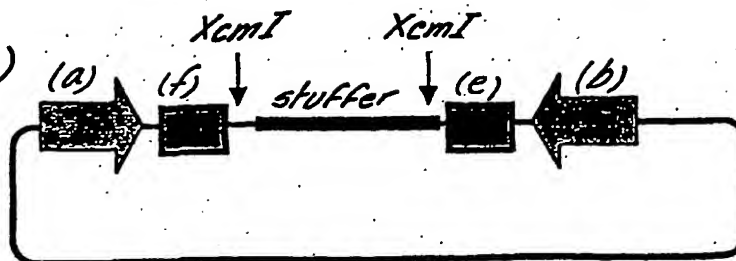
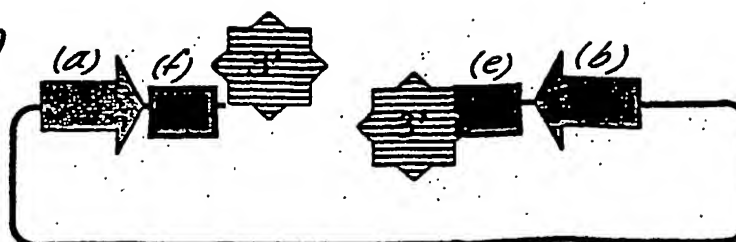


FIG. 2(f)



Construction RNAi vector with T7 terminators

FIG. 3.

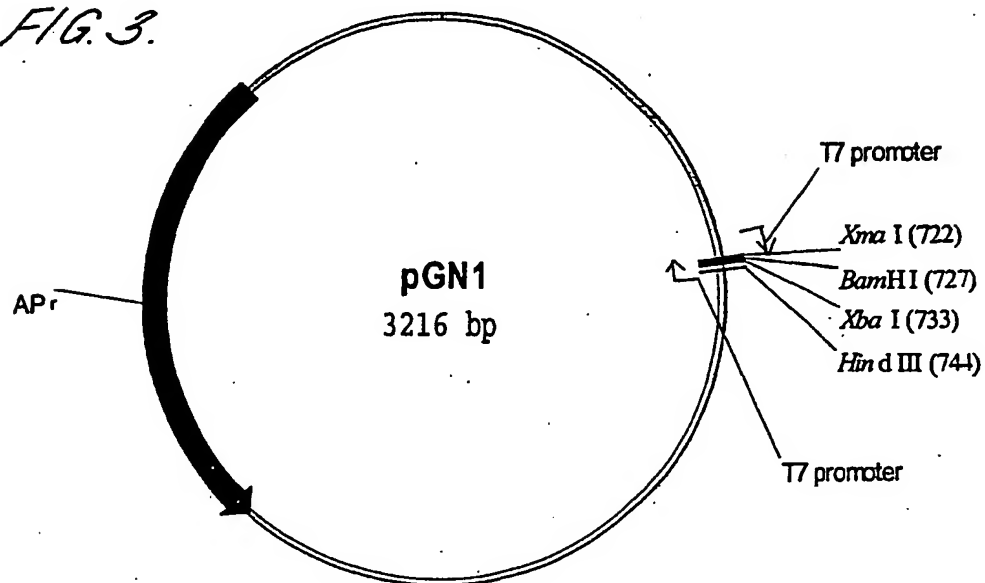


FIG. 4.

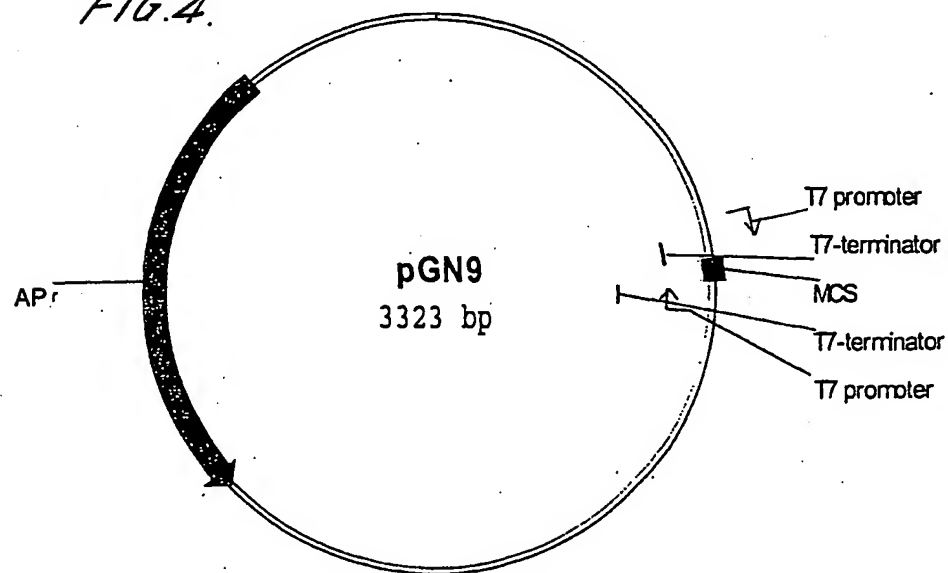


FIG. 5.

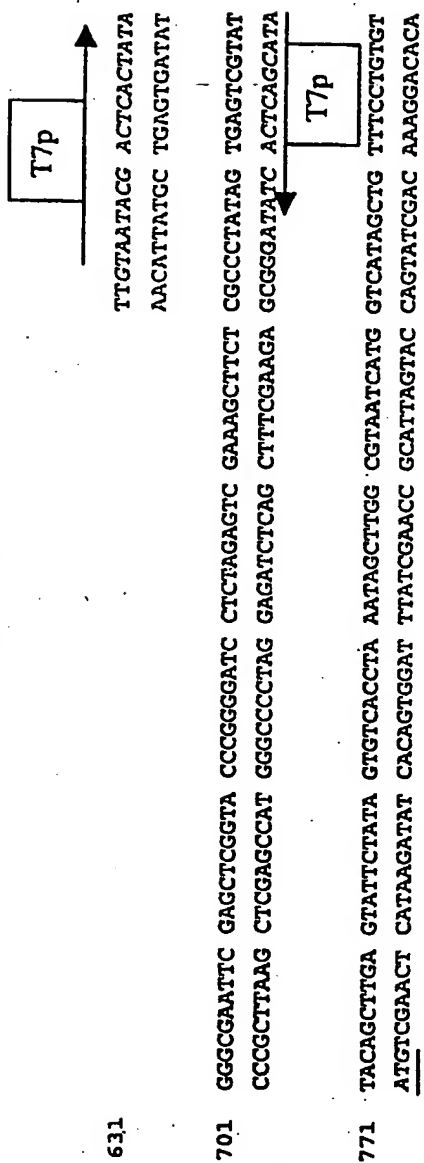
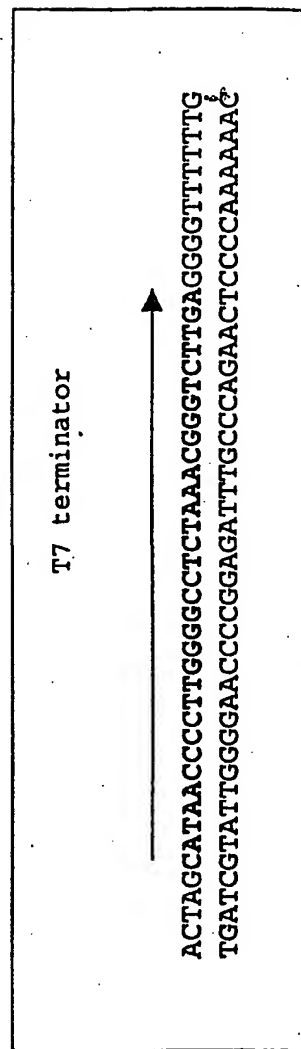


FIG. 6.



2. G/F

EcoRI com. T7 terminator EcoRI PstI KpnI
 OGN27 5' AATTCAAAAAACCCCTCAAGACCCCGTTTAGAGGCCCCAAGGGGTTATGCTAGTGAATTCTGCAGCGGTAC 3'
 OGN28 3' GTTTTTTGGGGAGTTCTGGGCAAAATCTCCGGGGTTCCCCAATACGATCACTTAAGACGTCGC 5'

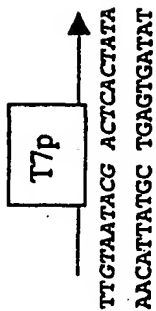
T7 terminator
 ↓

XbaI MluI HindIII T7 terminator HindIII com.

OGN 29 5' CTAGACGCGTAAGCTTACTAGCATAAACCCCTTGGGGCCCTCTAAACGGGTCTTGAGGGGTTTTTG 3'
 OGN 30 3' TGCGCATTCGAATGATCGTATTGGGGGAACCCCGGAGATTGCCCCAGAACTCCCCCAAAAAAAGCTCGA 5'

FIG. 8.

631



701

GGGCGAATTC AAAAACCCTC TCAAGACCCG TTTAGAGGCC CCAAGGGGTT ATGCTAGTGA ATTCTGCAGG
CCCGCTTAAG TTTTCTGGG AGTTCTGGG AATCTCCGG GGTCCCCAA TAGCATCACT TAAGACGTCC

T7 term

T7 term

771

GTACCCGGG ATCCTCTAGA CGCGTAAGCT TACTAGCATA ACCCTTGGG GCCTCTAAC GGGTCTTGAG
CATGGGCCC TAGGAGATCT GCGCATTGGA ATGATCGTAT TGGGGAACCC CGGAGATTG CCCAGAACTC

841

GGGTTTTTG AGCTTCTCGC CCTATAGTGA GTCGTATTAC AGCTTGAGTA TTCTATAGTG TCACCTAAAT
CCCAAAAAAC TCGAAGAGCG GGATATCACT CAGCATAATG TCGAACTCAT AAGATATCAC AGTGGATTTA

T7p

FIG. 9.

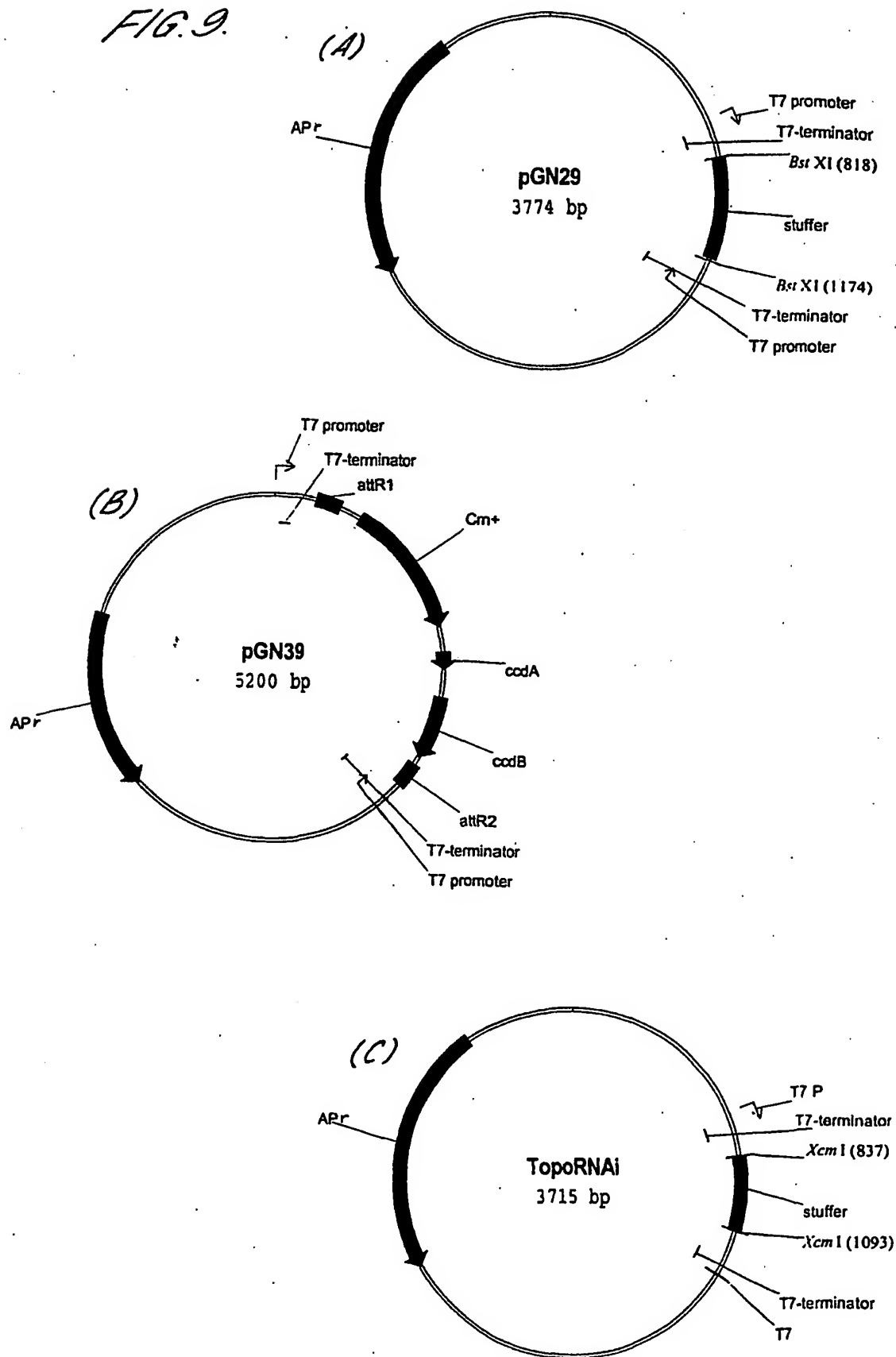


FIG. 10.

pGN9

```

1 gagtgcacca tatgcggtgt gaaataccgc acagatgcgt aaggagaaaa taccgcatca
61 ggcgaaattg taaacgttaa tattttgtta aaattcgcgt taaatatttg ttaaatacgc
121 tcatttttta accaataggg cgaaatcggc aaaatccctt ataaatcaaa agaatagacc
181 gagatagggg tgagtgttgt tccagtttgg aacaagagtc cactattaaa gaacgtggac
241 tccaacgtca aagggcgaaa aaccgtctat cagggcgatg gccactacg tgaaccatca
301 cccaaatcaa gttttttgcg gtcgaggtgc cgtaaagctc taaatcggaa ccctaaaggg
361 agcccccgat ttagagcttg acggggaaaag ccgcggaacg tggcgagaaa ggaagggaag
421 aaagcgaaag gagcgggccc tagggcgctg gcaagtgtag cggtcacgct gcgcgtaacc
481 accacacccg ccgcgcttaa tgcgcgcta cagggcgctg ccattcgcca ttcaggctgc
541 gcaactgttg ggaaggcgga tcggtgcccc cctcttcgct attacgccag ctggcgaaag
601 ggggatgtgc tgcaaggcga ttaagttggg taacgccagg gttttcccag tcacgacgtt
661 gtaaaacgac ggccagttaa ttgtaatacg actcactata gggcgaattc aaaaaacccc
721 tcaagacccg tttagaggcc ccaaggggtt atgtagtgga attctgcagg gtaccggggg
781 atcctctaga cgcgtaagct tactagcata accccttggg gcctctaaac gggcttgag
841 ggggtttttg agcttctcgc cctatagtga gtcgtattac agcttgagta ttctatagt
901 tcacctaata agcttgccgt aatcatgttc atagctgttt cctgtgtgaa attgttatcc
961 gctcacaatt ccacacaaca tacgagccgg aagcataaag tgtaaagcct ggggtgccta
1021 atgagtgagc taactcacat taattgcgtt gcgctcactg cccgctttcc agtcgggaaa
1081 cctgtcgtgc cagctgcatt aatgaatcgg ccaacgcgcg gggagaggcg gtttgcgtat
1141 tgggcgctct tccgcttccc cgtcactga ctcgctgcgc tcggtcgttc ggctgcggcg
1201 agcggtatca gctcactcaa agcgggtaat acggttatcc acagaaatcag gggataacgc
1261 aggaagaaac atgtgagcaa aagggccagca aaaggccagg aaccgtaaaa aggcgcggtt
1321 gctggcggtt ttcgataggc tccgcccccc tgacgagcat cacaaaaatc gacgctcaag
1381 tcagagggtg cgaaaccgga caggactata aagataccag gcgtttcccc ctggaagctc
1441 cctcgtgcgc tctcctgttc cgaccctgcc gcttaccgga tacctgtccg cctttctccc
1501 ttcgggaagc gtggcgcttt ctcatagctc acgctgtagg tatctcagtt cgggtgaggt
1561 cgctgcgtcc aagctgggct gtgtgcacga acccccgcgt cagcccagcc gctgcgcctt
1621 atccggtaac tatcgtcttg agtccaaccc ggtaagacac gactatcgc cactgcgagc
1681 agccactggt aacaggatta gcagagcgag gtatgtaggc ggtgctacag agttcttgaa
1741 gtgggtggcct aactacggct acactagaag gacagtattt ggtatctgcg ctctgctgaa
1801 gccagttacc ttcggaaaaa gagttggtag ctcttgatcc ggcaaacaaa ccaccgtgg
1861 tagcgggtgt tttttgttt gcaagcagca gattacgcgc agaaaaaaag gactctcaag
1921 agatcctttg atcttttcta cggggtctga cgctcagtgg aacgaaaact cacgttaagg
1981 gatttttggtc atgagattat caaaaaggat cttcacctag atccttttaa attaaaaatg
2041 aagtttttaa tcaatctaaa gtatatatga gtaaaacttg tctgacagtt accaatgctt
2101 aatcagtgag gcaacctatc cagcgatctg tctatttcgt tcatccatag ttgcctgact
2161 ccccgctcgt tagataacta cgatacggga gggcttacca tctggcccca gtgctgcaat
2221 gataccgcga gacccacgct caccggctcc agatttatca gcaataaacc agccagccgg
2281 aagggccgag cgcagaagtg gtcctgcaac tttatccgcc tccatccagt ctattaatg
2341 ttgcgggaa gctagagtaa gtagttcgcc agttaatagt ttgcgcaacg ttgttggcat
2401 tgctacaggg atcgtggtgt cacgctcgtc gtttggtatg gcttcattca gctccggttc
2461 ccaacgatca aggcgagtta catgatcccc catgttggtg aaaaaagcgg ttagctcctt
2521 cggctcctcc atcgttgtca gaagtaagtt ggcgcgagtg ttatcactca tgggtatggc
2581 agcactgcat aattctctta ctgtcatgcc atccgtaaga tgctttctg tgactgggtg
2641 gtactcaacc aagtcattct gagaataccg cgcccgcgga ccgagttgct cttgcccggc
2701 gtcaatacgg gataatagtg tatgacatag cagaacttta aaagtgtca tcattggaaa
2761 acgttctctg gggcgaaaac tctcaaggat cttaccgctg ttgagatcca gttcgatgta
2821 accactcgt gcaccaact gatcttcagc atcttttact ttcacagcg tttctgggtg
2881 agcaaaaaa ggaaggcaaa atgccgcaaa aaagggaata agggcgacac ggaaatgttg
2941 aatactcata ctcttctctt ttcaatatta ttgaagcatt tatcagggtt attgtctcat
3001 gagcggatac atatttgaat gtatttagaa aaataaacia atagggggtc cgcgcacatt
3061 tcccgaaaa gtgccacctg acgtctaaaga aaccattatt atcatgacat taacctataa
3121 aaataggcgt atcacgaggg cctttcgtct cgcgcggttc ggtgatgacg gtgaaaaact
3181 ctgacacatg cagctcccg agacggctac agcttgctg taagcggatg ccgggagcag
3241 acaagcccg cagggcgctg cagcgggtgt tggcgggtgt cggggtcggc ttaactatgc
3301 ggcacagag cagattgtac tga

```

FIG. 11.

PGN29

```

1  gagtgcacca tatgcggtgt gaaataccgc acagatgcgt aaggagaaaa taccgcatca
61  ggcgaaattg taaacgttaa tattttgtta aaattcgcgt taaatatttg ttaaatacagc
121 tcatttttta accaataggg cgaaatcggc aaaatccctt ataatcaaaa agaatagacc
181 gagatagggt tgagtgttgt tccagtttgg aacaagagtc cactattaaa gaacgtggac
241 tccaaactca aagggcgaaa aaccgtctat cagggcgatg gccactacg tgaacatca
301 cccaaatcaa gttttttgcg gtcgaggtgc cgtaaagctc taaatcgaa ccctaaagg
361 agccccgat ttagagcttg acggggaaa cgggcgaacg tggcgagaaa ggaagggaag
421 aaagcgaaag gagcggcgcg tagggcgctg gcaagtgtag cggtcacgct gcgcgtaacc
481 accacacccg ccgcgcttaa tgcgcgctta cagggcgctg ccattcgcca ttcaggctgc
541 gcaactgttg ggaagggcga tcggtgcggg cctcttcgct attacgccag ctggcgaaa
601 ggggatgtgc tgcaaggcga ttaagttggg taacgccagg gttttccag tcacgacgtt
661 gtaaaacgac ggccagtga tttgaatac actcactata gggcgaaatt aaaaaacccc
721 tcaagacccg tttagaggcc ecaaggggtt atgctagtga attctgcagg gtacccgggg
781 atcctctaga gatccctcga cctcgagatc cattgtgctg gcgcggattc tttatcactg
841 ataagttggg ggacataatta tgtttatcag tgataaagt tcaagcatga caaagttgca
901 gccgaataca gtgatccgtg ccggccctgg actgttgaa caggctcggt tagacggtct
961 gacgacacgc aaactggcgg aacggttggg ggtgcagcag ccggcgcttt actggcactt
1021 caggaacaag cgggcgctgc tcgacgcact ggccgaagcc atgctggcgg agaatacatac
1081 gcttcggtgc cgagagccga cgacgactgg cgctcatttc tgatcgggaa tcccgcagct
1141 tcaggcaggc gctgctcgcc taccgccagc acaatggatc tcgagggatc tccatacct
1201 accagttctg cgctgcagg tcgcggcgcg gactctctag acgcgtaagc ttactagcat
1261 aacccttggt ggctctaaa cgggtcttga ggggtttttt gagcttctcg ccctatagtg
1321 agtcgtatta cagcttgagt attctatagt gtcacctaaa tagcttggcg taatcatggt
1381 catagctgtt tcctgtgtga aattgttate cgctcacaat tccacacacg atacgagccg
1441 gaagcataaa gtgtaaaagc tgggtgctct aatgagttag ctaactcaca ttaattgcgt
1501 tgcgctcact gcccgcttcc cagtcgggaa acctgtcgtg ccagctgcat taatgaatcg
1561 gccaacgcgc ggggagaggg ggtttgcgta ttgggcgctc ttcgcgttcc tcgctcactg
1621 actcgctcgc ctcggtcggt cggctgcggc gagcggatc agctcactca aaggcggtaa
1681 tacggttatc cacagaatca caggaaagaa catgtgagca aaaggccagc
1741 aaaaggccag gaaccgtaaa aaggccgcgt tgctggcggt tttcgatagg ctccgcccc
1801 ctgacgagca tcacaaaaat cgacgctcaa gtcagaggtg gcgaaacccg acaggactat
1861 aaagatacca ggcgtttccc cctggaagct ccctcgctgc ctctcctggt ccgacactgc
1921 cgcttacggg atacctgtcc gcctttctcc cttcggaag cgtggcgctt tctcatagct
1981 cagctgttag gtatctcagt tcggtgtagg tcgttcgctc caagctgggc tgtgtgcacg
2041 aacccccctg tcagccccgac cgctgcgcct tatccggtaa ctatcgctctt gagtccaacc
2101 cggtaagaca cgacttatcg ccactggcag cagccactgg taacaggatt agcagagcga
2161 ggtatgtagg cgggtctaca gagttcttga agtgggtggc taactacggc tacactagaa
2221 ggacagtatt tggatctgac gctctgctga agccagttac cttcggaaaa agagtggta
2281 gctcttgatc cggcaaaaca accaccgctg gtacgggtgg ttttttgggt tgcaagcagc
2341 agattacgcg cagaaaaaaa ggtatcgaag aagatccttt gatctttctg acggggtctg
2401 acgtcagtg gaacgaaaac tcacgtttaag ggattttgggt catagatta caaaaagga
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2521 agtaaaactg gtctgacagt taccaatgct taatcagtga ggcacctatc tcagcgatct
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2641 agggcttacc atctggcccc agtgctgcaa tgataccgcg agaccacgc tcaccggctc
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2881 cgatttggat ggcttcattc agctccggtt cccaacgata aaggcgagtt acatgctccc
2941 ccatgtttg caaaaaagcg gttagctcct tcggctcctc gatcgttgct agaagtaagt
3001 tggccgcagt gttatcactc atgggttatg cagcactgca taattctctt actgtcatgc
3061 catccgtaag atgcttttct gtgactgggt agtactcaac caagtcatc tgagaatacc
3121 gcgcccggcg accgagttgc cttgcccgg cgtcaatacg ggataatagt gtatgcata
3181 gcagaacttt aaaaagtgtc atcatttgaa aacgttcttc gggcgaaaa ctctcaagga
3241 tcttaccgct gttgagatcc agttcgatgt aacccactcg tgcaccaaac tgatcttcag
3301 catcttttac tttcaccagc gtttctgggt gagcaaaaac aggaaggcaa aatgccgcaa
3361 aaaagggaat aagggcgaca cggaaatgtt gaatactcat actcttctt tttcaatatt
3421 attgaagcat ttatcagggt tattgtctca tgagcggata catatttgaa tgtatttaga
3481 aaaataaaca aataggggtt ccgcgcacat tccccgaaa agtgccacct gacgtctaag
3541 aaaccattat tatcatgaca ttaacctata aaaataggcg tatcacgagg cctttctgct
3601 tcgcgcggtt cggtgatgac ggtgaaaacc tctgacacat gcagctcccg gagacggtca
3661 cagcttgtct gtaagcggat gccgggagca tcaggcgcg tcagggggtg
3721 ttggcgggtg tcggggctgg ctttaactat cggcatcaga gcagattgta ctga

```

*FIG. 12.**PGK39*

TAATACGACT CACTATAGGG CGAATTCAAA AAACCCCTCA AGACCCGTTT
AGAGGCCCCA AGGGGTTATG CTAGTGAATT CTGCAGCGGT ACCCGGGGAT
CCTCTAGAGA TCCCTCGACC TCGAGATCCA TTGTGCTGGA AAGATCACAA
GTTTGTACAA AAAAGCTGAA CGAGAAACGT AAAATGATAT AAATATCAAT
ATATTAAATT AGATTTTGCA TAAAAACAG ACTACATAAT ACTGTAAAC
ACAACATATC CAGTCACTAT GCGGCCCGCA TTAGGCACCC CAGGCTTTAC
ACTTTATGCT TCCGGCTCGT ATAATGTGTG GATTTTGAGT TAGGATCCGG
CGAGATTTTC AGGAGCTAAG GAAGCTAAAA TGGAGAAAAA AATCACTGGA
TATACCACCG TTGATATATC CCAATGGCAT CGTAAAGAAC ATTTTGAGGC
ATTTCACTCA GTTGCTCAAT GTACCTATAA CCAGACCGTT CAGCTGGATA
TTACGGCCTT TTTAAAGACC GTAAAGAAAA ATAAGCACAA GTTTTATCCG
GCCTTTATTC ACATTCTTGC CCGCCTGATG AATGCTCATC CGGAATTCCG
TATGGCAATG AAAGACGGTG AGCTGGTGAT ATGGGATAGT GTTCAACCCTT
GTTACACCGT TTTCCATGAG CAAACTGAAA CGTTTTTCATC GCTCTGGAGT
GAATACCACG ACGATTTCCG GCAGTTTCTA CACATATATT CGCAAGATGT
GGCGTGTTAC GGTGAAAACC TGGCCTATTT CCCTAAAGGG TTTATTGAGA
ATATGTTTTT CGTCTCAGCC AATCCCTGGG TGAGTTTCAC CAGTTTTGAT
TTAAACGTGG CCAATATGGA CAACTTCTTC GCCCCCGTTT TCACCATGGG
CAAATATTAT ACGCAAGGCG ACAAGGTGCT GATGCCGCTG GCGATTGAGG
TTCATCATGC CGTCTGTGAT GGCTTCCATG TCGGCAGAAT GCTTAATGAA
TTACAACAGT ACTGCGATGA GTGGCAGGGC GGGGCGTAAA GATCTGGATC
CGGCTTACTA AAAGCCAGAT AACAGTATGC GTATTTGCGC GCTGATTTTT
GCGGTATAAG AATATATACT GATATGTATA CCCGAAGTAT GTCAAAAAGA
GGTGTGCTAT GAAGCAGCGT ATTACAGTGA CAGTTGACAG CGACAGCTAT
CAGTTGCTCA AGGCATATAT GATGTCAATA TCTCCGGTCT GGTAAAGACA
ACCATGCAGA ATGAAGCCCG TCGTCTGCGT GCCGAACGCT GGAAAGCGGA
AAATCAGGAA GGGATGGCTG AGGTCGCCCC GTTTATTGAA ATGAACGGCT
CTTTTGCTGA CGAGAACAGG GACTGGTGAA ATGCAGTTTA AGGTTTACAC
CTATAAAGA GAGAGCCGTT ATCGTCTGTT TGTGGATGTA CAGAGTGATA
TTATTGACAC GCCCGGGCGA CGGATGGTGA TCCCCCTGGC CAGTGCACGT
CTGCTGTCAG ATAAAGTCTC CCGTGAACCT TACCCGGTGG TGCATATCGG
GGATGAAAGC TGGCGCATGA TGACCACCGA TATGGCCAGT GTGCCGGTCT
CCGTTATCGG GGAAGAAGTG GCTGATCTCA GCCACCGCGA AAATGACATC
AAAAACGCCA TTAACCTGAT GTTCTGGGGA ATATAAATGT CAGGCTCCCT
TATACACAGC CAGTCTGCAG GTCGACCATA GTGACTGGAT ATGTTGTGTT
TTACAGTATT ATGTAGTCTG TTTTATATGC AAAATCTAAT TTAATATATT
GATATTTATA TCATTTTACG TTTCTCGTTC AGCTTTCTTG TACAAAGTGG
TGATCTTTCC AGCACAATGG ATCTCGAGGG ATCTTCATA CCTACCAGTT
CTGCGCCTGC AGGTCGCGGC CGCGACTCTA GACGCGTAAG CTTACTAGCA
TAACCCCTTG GGGCCTCTAA ACGGGTCTTG AGGGGTTTTT TGAGCTTCTC
GCCCTATAGT GAGTCGTATT ACAGCTTGAG TATTCTATAG TGTACCTAA
ATAGCTTGGC GTAATCATGG TCATAGCTGT TTCCTGTGTG AAATTGTTAT
CCGCTCACAA TTCCACACAA CATACGAGCC GGAAGCATAA AGTGTAAGC

FIG. 12 (CONTINUED 1)

CTGGGGTGCC TAATGAGTGA GCTAACTCAC ATTAATTGCG TTGCGCTCAC
 TGCCCGCTTT CCAGTCGGGA AACCTGTCGT GCCAGCTGCA TTAATGAATC
 GGCCAACGCG CGGGGAGAGG CGGTTTGCGT ATTGGGCGCT CTTCCGCTTC
 CTCGCTCACT GACTCGCTGC GCTCGGTCGT TCGGCTGCGG CGAGCGGTAT
 CAGCTCACTC AAAGGCGGTA ATACGGTTAT CCACAGAATC AGGGGATAAC
 GCAGGAAAGA ACATGTGAGC AAAAGGCCAG CAAAAGGCCA GGAACCGTAA
 AAAGGCCGCG TTGCTGGCGT TTTTCGATAG GCTCCGCCCC CCTGACGAGC
 ATCACA AAAA TCGACGCTCA AGTCAGAGGT GGCAGAAACC GACAGGACTA
 TAAAGATACC AGGCGTTTCC CCCTGGAAGC TCCCTCGTGC GCTCTCCTGT
 TCCGACCCTG CCGCTTACCG GATACCTGTC CGCCTTCTCT CCTTCGGGAA
 GCGTGGCGCT TTCTCATAGC TCACGCTGTA GGTATCTCAG TTCGGTGTAG
 GTCGTTGCGT CCAAGCTGGG CTGTGTGCAC GAACCCCCCG TTCAGCCCGA
 CCGCTGCGCC TTATCCGGTA ACTATCGTCT TGAGTCCAAC CCGGTAAGAC
 ACGACTTATC GCCACTGGCA GCAGCCACTG GTAACAGGAT TAGCAGAGCG
 AGGTATGTAG GCGGTGCTAC AGAGTTCTTG AAGTGGTGGC CTAACACGG
 CTACACTAGA AGGACAGTAT TTGGTATCTG CGCTCTGCTG AAGCCAGTTA
 CCTTCGGAAA AAGAGTTGGT AGCTCTTGAT CCGGCAAAACA AACCACCGCT
 GGTAGCGGTG GTTTTTTTGT TTGCAAGCAG CAGATTACGC GCAGAAAAAA
 AGGATCTCAA GAAGATCCTT TGATCTTTTC TACGGGGTCT GACGCTCAGT
 GGAACGAAAA CTCACGTTAA GGGATTTTGG TCATGAGATT ATCAAAAAGG
 ATCTTCACCT AGATCCTTTT AAATTAAAAA TGAAGTTTTA AATCAATCTA
 AAGTATATAT GAGTAACTT GGTCTGACAG TTACCAATGC TTAATCAGTG
 AGGCACCTAT CTCAGCGATC TGTCTATTTT GTTCATCCAT AGTTGCCTGA
 CTCCCCGTCG TGTAGATAAC TACGATACGG GAGGGCTTAC CATCTGGCCC
 CAGTGCTGCA ATGATACCGC GAGACCCACG CTCACCGGCT CCAGATTAT
 CAGCAATAAA CCAGCCAGCC GGAAGGGCCG AGCGCAGAAG TGGTCCTGCA
 ACTTTATCCG CCTCCATCCA GTCTATTAAT TGTGCCCCGG AAGCTAGAGT
 AAGTAGTTCG CCAGTTAATA GTTTGCGCAA CGTTGTTGGC ATTGCTACAG
 GCATCGTGGT GTCACGCTCG TCGTTTGGTA TGGCTTCATT CAGTCCGGT
 TCCCAACGAT CAAGGCGAGT TACATGATCC CCCATGTTGT GCAAAAAGC
 GGTTAGCTCC TTCGGTCCTC CGATCGTTGT CAGAAGTAAG TTGGCCGCAG
 TGTTATCACT CATGTTTATG GCAGCACTGC ATAATTCTCT TACTGTCTG
 CCATCCGTAA GATGCTTTTC TGTGACTGGT GAGTACTCAA CCAAGTCATT
 CTGAGAATAC CGCGCCCGGC GACCGAGTTG CTCTTGCCCC GCGTCAATAC
 GGGATAATAG TGTATGACAT AGCAGAACTT TAAAAGTGCT CATCATTGGA
 AAACGTTCTT CGGGGCGAAA ACTCTCAAGG ATCTTACCGC TGTGAGATC
 CAGTTCGATG TAACCCACTC GTGCACCCAA CTGATCTTCA GCATCTTTTA
 CTTTCACCAG CGTTTCTGGG TGAGCAAAAA CAGGAAGGCA AAATGCCGCA
 AAAAAGGGAA TAAGGGCGAC ACGGAAATGT TGAATACTCA TACTCTTCCT
 TTTTCAATAT TATTGAAGCA TTTATCAGGG TTATTGTCTC ATGAGCGGAT
 ACATATTGTA ATGTATTTAG AAAAATAAAC AAATAGGGGT TCCGCGCACA
 TTTCCCCGAA AAGTGCCACC TGACGTCTAA GAAACCATTA TTATCATGAC
 ATTAACCTAT AAAAATAGGC GTATCACGAG GCCCTTTCGT CTCGCGCGTT
 TCGGTGATGA CGGTGAAAAC CTCTGACACA TGCAGCTCCC GGAGACGGTC
 ACAGCTTGTC TGTAAGCGGA TGCCGGGAGC AGACAAGCCC GTCAGGGCGC
 GTCAGCGGGT GTTGGCGGGT GTCGGGGCTG GCTTAACTAT GCGGCATCAG

FIG. 12 (CONTINUED 2)

AGCAGATTGT ACTGAGAGTG CACCATATGC GGTGTGAAAT ACCGCACAGA
TGCCTAAGGA GAAAATACCG CATCAGGCGA AATTGTAAAC GTTAATATTT
TGTTAAATTT CGCGTTAAAT ATTTGTATAA TCAGCTCATT TTTTAACCAA
TAGGCCGAAA TCGGCAAAAT CCCTTATAAA TCAAAAGAAT AGACCGAGAT
AGGGTTGAGT GTTGTTCAG TTTGGAACAA GAGTCCACTA TTAAAGAACG
TGGACTCCAA CGTCAAAGGG CGAAAAACCG TCTATCAGGG CGATGGCCCA
CTACGTGAAC CATCACCCAA ATCAAGTTTT TTGCGGTCGA GGTGCCGTAA
AGCTCTAAAT CGGAACCCTA AAGGGAGCCC CCGATTTAGA GCTTGACGGG
GAAAGCCGGC GAACGTGGCG AGAAAGGAAG GGAAGAAAGC GAAAGGAGCG
GGCGCTAGGG CGCTGGCAAG TGTAGCGGTC ACGCTGCGCG TAACCACCAC
ACCCGCCGCG CTTAATGCGC CGCTACAGGG CGCGTCCATT CGCCATTGAG
GCTGCGCAAC TGTGGGAAG GGCATCGGT GCGGGCCTCT TCGCTATTAC
GCCAGCTGGC GAAAGGGGGA TGTGCTGCAA GGCGATTAAG TTGGGTAACG
CCAGGGTTTT CCCAGTCACG ACGTTGTAAA ACGACGGCCA GTGAATTG

FIG. 13.

TopoRNAi

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1  gagtgcacca tatgcggtgt gaaataccgc acagatgcgt aaggagaaaa taccgcatca
61  ggcgaaattg taaacgttaa tattttgtta aaattcgcgt taaatatattg ttaaatacagc
121  tcatttttta accaataggc cgaatccggt aaaatccctt ataaatcaaaa agaataagacc
181  gagatagggg tgcgtgtgtt tccagtttgg aacaagagtc cactattaaa gaacgtggac
241  tccaacgtca aagggcgaaa aaccgtctat cagggcgatg gcccactacg tgaaccatca
301  cccaaatcaa gttttttgct gtcgaggtgc cgtaaagctc taaatcggaa ccctaaaggg
361  agcccccgat ttagagcttg acggggaaa cggcgaaacg tggcgagaaa ggaagggaa
421  aaagcgaag gagcgggccc tagggcgctg gcaagtgtag cggtcacgct cggcgtaacc
481  accacacccg ccgcgcttaa tgcgcgcta cagggcgctg ccattcgcca ttcaggctgc
541  gcaactgttg ggaagggcga tgcgtgcgg cctcttcgct attacgccag ctggcgaaa
601  ggggatgtgc tgcaggcga ttaagttggg taacgccagg gttttccacg tcacgcaggt
661  gtaaaacgac ggccagtga actcactata gggcgaaattc aaaaaacccc
721  tcaagacccg tttagaggcc ccaaggggtt atgctagtga attctgcagg gtacccgggg
781  atcctctaga gatccctcga cctcgagatc cattgtgggt gaattctacc aaggctagca
841  tgggcagccg aatacagtga tccgtgccgg ccctggactg ttgaacgagg tcggcgtaga
901  cggctgacg acacgcaaac cgctgctcga cgcactggcc cagcagccgg cagcagccgg
961  gcacttcagg aacaagcggg agccgacgac gactggcgct cattctgat cggaatccc
1021  tcatacgtt cggtgccgag agaatccac cacaatggat ctgcagggat cttccatacc
1081  gcagccatgc tagccttggg gtcgcggccg cgactctcta gacgcgtaag cttactagca
1141  taccagttct gcgcctgcag aggggtcttg aggggttttt tgagcttctc gccctatagt
1201  taaccctctg gggcctctaa tattctatag tgtcacctaa atagcttggc gtaatcatgg
1261  gagtcgtatt acagcttgag aaattgttat ccgctcacia ttccacacaa catacgagcc
1321  tcatagctgt ttcctgtgtg ctggggtgcc taatgagtga gctaactcac attaatggcg
1381  ggaagcataa agtgtaaaag ccagtcggga aacctgtcgt gccagctgca ttaatgaatc
1441  ttgcgctcac tgcccgcttt cgggttgctg attggcgctt cttccgcttc ctgcctcact
1501  ggcgaacgag cggggagagg gctcggctcg cgagcgggat cagctcactc aaaggcggta
1561  gactcgctgc gctcggctcg aggggataac gcaggaaaga acatgtgagc aaaaggccag
1621  atacggttat ccacagaatc aaaggccgag ttgctggcgt ttttcgatag gctccgcccc
1681  caaaaggcca ggaaccgtaa tgcagctca agtcagaggt ggcgaaaccc gacaggacta
1741  cctgacgagc atcacaaaaa ccctggaagc tccctcgctg gctctcctgt tccgacctg
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1861  ccgcttacg ggtatctcag ttcggtgtg gtcgttcgct ccaagctggg ctggtgcac
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1981  gaaccccccg ttcagcccg ggcacttgca gcagccactg gtaacaggat tagcagagcg
2041  ccggtaaagc acgacttatc agagttcttg aagtgggtgg ctaactacgg ctacactaga
2101  aggtatgtag ggcgtgctac agctctgctg aagccagtta aagagttggg aagagttggg
2161  aggtatgtat ttggtatctg cgtctgctg ggtagcgggt gtttttttgt ttgcaagcag
2221  agctcttgat cgggcaaaaa accacogct gaagatcctt tgatcttttc tacgggggtc
2281  cagattacgc gcagaaaaaa ctcacgttaa gggatttttg tcatgagatt atcaaaaagg
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2401  atcttcacct agatcctttt ttaccaatgc ttaatcagtg aggcacctat ctacgcgac
2461  gagtaaaact ggtctgacag agttgcctga ctccccgctg tgtagataac tacgatacgg
2521  tgtctatttc gttcatccat cagtgtgcga atgataccgc gagaccacg ctcacgggct
2581  gagggcttac catctggccc ccagccagcc ggaaggggcg agcgcagaag tggctcctgca
2641  ccagatttat cagcaataaa gtctattaat tgttgccggg aagctagagt aagtagttcg
2701  actttatccg cctccatcca cgttgctggc attgctacag gcatcggtgt gtcacgctcg
2761  ccagtttaata gtttgcgcaa cagctccggt tcccaacgat caaggcgagt tacatgatcc
2821  tgcgtttggt tggcttcatt ggttagctcc ttcggtcctc cagatcgttg cagaagtaag
2881  cccatgttgt gcaaaaaagc catggttatg gcagcactgc ataattctct tactgtcatg
2941  ttggccgcag tgttatcact tgtgactggt gagtactcaa ccaagtcatt ctgagaatac
3001  ccacccgtaa gatgcttttc ctcttgccc ggcgcaatac gggataatag tgtatgacat
3061  cgcgcccggc gaccgagttg catcattgga aacggttctt cggggcgaaa actctcaagg
3121  agcagaactt taaaagtgtc cagttcgatg taaccactc gtgcaccaa ctgatcttca
3181  atcttacccg tgttgagatc cgtttctggg tgagcaaaaa caggaaggca aaatgccgca
3241  gcatctttta ctttcaccag acggaaatgt tgaatactca tactcttctt tttcaatat
3301  aaaaagggaa ttaaggcgac ttattgtctc atgagcggat acatatattg atgtatttag
3361  taaataaac aaatagggt tccgcgcaca tttcccggaa aagtgccacc aagtgccacc
3421  gaaaccatta ttatcatgac attaacctat aaaaataggc gtatcacgag gtcagctccc
3481  ctgcgcggtt tgcgtgatga cgggaaaaac ctctgacaca tgcagctccc gtcagggcgc
3541  acagcttgct tgaagcggg tgccgggagc agacaagccc gtcagggcgc gtcaggggt
3601  acagcttgct tgaagcggg gtcggggctg gcttaactat gcgcatcag agcagattgt
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pgn49A *FIG. 14.*

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TGTAATACGA CTCACTATAG GGCGAATTCA AAAAACCCTT CAAGACCCGT
TTAGAGGCCC CAAGGGGTTA TGCTAGTGAA TTCTGCAGCG GTACCCGGGG
ATCCTCTAGA GATCCCTCGA CCTCGAGATC CATTTGTGCTG GAAAGGATCT
GGATCCGGCT TACTAAAAGC CAGATAACAG TATGCGTATT TGCGCGCTGA
TTTTTGCGGT ATAAGAATAT ATACTGATAT GTATACCCGA AGTATGTCAA
AAAGAGGTGT GCTATGAAGC AGCGTATTAC AGTGACAGTT GACAGCGACA
GCTATCAGTT GCTCAAGGCA TATATGATGT CAATATCTCC GGTCTGGTAA
GCACAACCAT GCAGAATGAA GCCCGTCGTC TGCGTGCCGA ACGCTGGAAA
GCGGAAAAATC AGGAAGGGAT GGCTGAGGTC GCCCGGTTTA TTGAAATGAA
CGGCTCTTTT GCTGACGAGA ACAGGGACTG GTGAAATGCA GTTTAAGGTT
TACACCTATA AAAGAGAGAG CCGTTATCGT CTGTTTGTGG ATGTACAGAG
TGATATTATT GACACGCCCG GGCGACGGAT GGTGATCCCC CTGGCCAGTG
CACGTCTCTT AAGCGATAAA GTCTCCCGTG AACTTTACCC GGTGGTGCAT
ATCGGGGATG AAAGCTGGCG CATGATGACC ACCGATATGG CCAGTGTGCC
GGTCTCCGTT ATCGGGGAAG AAGTGGCTGA TCTCAGCCAC CGCGAAAATG
ACATCAAAAA CGCCATTAAC CTGATGTTCT GGGGAATATA AATGTCAGGC
TCCCTTATAC ACAGCCTTTC CAGCACAATG GATCTCGAGG GATCTTCCAT
ACCTACCAGT TCTGCGCCTG CAGGTCGCGG CCGCGACTCT AGACGCGTAA
GCTTACTAGC ATAACCCCTT GGGGCCTCTA AACGGGTCTT GAGGGGTTTT
TTGAGCTTCT CGCCCTATAG TGAGTCGTAT TACAGCTTGA GTATTCTATA
GTGTCACCTA AATAGCTTGG CGTAATCATG GTCATAGCTG TTTCCTGTGT
GAAATTGTTA TCCGCTCACA ATTCCACACA ACATACGAGC CGGAAGCATA
AAGTGTAAGC CCTGGGGTGC CTAATGAGTG AGCTAACTCA CATTAAATGC
GTTGCGCTCA CTGCCCGCTT TCCAGTCGGG AAACCTGTCTG TGCCAGCTGC
ATTAATGAAT CGGCCAACGC GCGGGGAGAG GCGGTTTGCG TATTGGGCGC
TCTTCCGCTT CCTCGCTCAC TGACTCGCTG CGCTCGGTCTG TCCGGCTGCG
GCGAGCGGTA TCAGCTCACT CAAAGCGGT AATACGGTTA TCCACAGAAT
CAGGGGATAA CGCAGGAAAG AACATGTGAG CAAAGGGCCA GCAAAGGCC
AGGAACCGTA AAAAGGCCGC GTTGCTGGCG TTTTTCGATA GGCTCCGCCC
CCCTGACGAG CATCACAAAA ATCGACGCTC AAGTCAGAGG TGGCGAAACC
CGACAGGACT ATAAAGATAC CAGGCGTTTC CCCCTGGAAG CTCCCTCGTG
CGCTCTCCTG TTCCGACCCT GCCGCTTACC GGATACCTGT CCGCCTTTCT
CCCTTCGGGA AGCGTGGCGC TTTCTCATAG CTCACGCTGT AGGTATCTCA
GTTCCGTGTA GGTGTTTCGC TCCAAGCTGG GCTGTGTGCA CGAACCCCCC
GTTACAGCCG ACCGCTGCGC CTTATCCGGT AACTATCGTC TTGAGTCCAA
CCCGGTAAGA CACGACTTAT CGCCACTGGC AGCAGCCACT GGTAACAGGA
TTAGCAGAGC GAGGTATGTA GGCGGTGCTA CAGAGTTCTT GAAGTGGTGG
CCTAACTACG GCTACACTAG AAGGACAGTA TTTGGTATCT GCGCTCTGCT
GAAGCCAGTT ACCTTCGGAA AAAGAGTTGG TAGCTCTTGA TCCGGCAAAC
AAACCACCGC TGGTAGCGGT GGTTTTTTTG TTTGCAAGCA GCAGATTACG
CGCAGAAAAA AAGGATCTCA AGAAGATCCT TTGATCTTTT CTACGGGGTC
TGACGCTCAG TGGAACGAAA ACTCAGCTTA AGGGATTTTG GTCATGAGAT
TATCAAAAAG GATCTTCACC TAGATCCTTT TAAATTAAAA ATGAAGTTTT

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FIG. 14 (CONTINUED)

AAATCAATCT AAAGTATATA TGAGTAACT TGGTCTGACA GTTACCAATG
CTTAATCAGT GAGGCACCTA TCTCAGCGAT CTGTCTATTT CGTTCATCCA
TAGTTGCC TG ACTCCCCGTC GTGTAGATAA CTACGATACG GGAGGGCTTA
CCATCTGGCC CCAGTGCTGC AATGATACCG CGAGACCCAC GCTCACCGGC
TCCAGATT TA TCAGCAATAA ACCAGCCAGC CGGAAGGGCC GAGCGCAGAA
GTGGTCCTGC AACTTTATCC GCCTCCATCC AGTCTATTAA TTGTTGCCCG
GAAGCTAGAG TAAGTAGTTC GCCAGTTAAT AGTTTGCGCA ACGTTGTTGG
CATTGCTACA GGCATCGTGG TGTACGCTC GTCGTTTGGT ATGGCTTCAT
TCAGCTCCGG TTCCCAACGA TCAAGGCGAG TTACATGATC CCCCATGTTG
TGCAAAAAAG CGGTTAGCTC CTTGCGTCTT CCGATCGTTG TCAGAAGTAA
GTGGCCGCA GTGTTATCAC TCATGTTAT GGCAGCACTG CATAATCTC
TTACTGT CAT GCCATCCGTA AGATGCTTTT CTGTGACTGG TGAGTACTCA
ACCAAGTCAT TCTGAGAATA CCGCGCCCGG CGACCGAGTT GCTCTTGCCC
GGCGTCAATA CGGGATAATA GTGTATGACA TAGCAGAACT TAAAAAGTGC
TCATCATTGG AAAACGTTCT TCGGGGCGAA AACTCTCAAG GATCTTACCG
CTGTTGAGAT CCAGTTCGAT GTAACCCACT CGTGCAACCA ACTGATCTTC
AGCATCTTTT ACTTTCACCA GCGTTTCTGG GTGAGCAAAA ACAGGAAGGC
AAAATGCCGC AAAAAAGGGA ATAAGGGCGA CACGGAAATG TTGAATACTC
ATACTCTTCC TTTTCAATA TTATTGAAGC ATTTATCAGG GTTATTGTCT
CATGAGCGGA TACATATTTG AATGTATTTA GAAAAATAAA CAAATAGGGG
TTCCGCGCAC ATTTCCCGA AAAGTGCCAC CTGACGTCTA AGAAACCATT
ATTATCATGA CATTAACTA TAAAAATAGG CGTATCACGA GGCCCTTTCG
TCTCGCGCGT TTCGGTGATG ACGGTGAAAA CCTCTGACAC ATGCAGCTCC
CGGAGACGGT CACAGCTTGT CTGTAAGCGG ATGCCGGGAG CAGACAAGCC
CGTCAGGGCG CGTCAGCGGG TGTTGGCGGG TGTCGGGGCT GGCTTAAC TA
TGCGGCATCA GAGCAGATTG TACTGAGAGT GCACCATATG CGGTGTGAAA
TACCGCACAG ATGCGTAAGG AGAAAATACC GCATCAGGCG AAATTGTAAA
CGTTAATATT TTGTTAAAT TCGCGTTAAA TATTTGTTAA ATCAGCTCAT
TTTTTAACCA ATAGGCCGAA ATCGGCAAAA TCCCTTATAA ATCAAAAGAA
TAGACCGAGA TAGGGTTGAG TGTTGTTCCA GTTTGGAACA AGAGTCCACT
ATTAAAGAAC GTGGACTCCA ACGTCAAAGG GCGAAAAACC GTCTATCAGG
GCGATGGCCC ACTACGTGAA CCATCACCCA AATCAAGTTT TTTGCGGTCTG
AGGTGCCGTA AAGCTCTAAA TCGGAACCTT AAAGGGAGCC CCCGATTAG
AGCTTGACGG GGAAGCCGG CGAACGTGGC GAGAAAGGAA GGGAAGAAAG
CGAAAGGAGC GGGCGCTAGG GCGCTGGCAA GTGTAGCGGT CACGCTGCGC
GTAACCACCA CACCCGCCGC GCTTAATGCG CCGCTACAGG GCGCGTCCAT
TCGCCATTCA GGCTGCGCAA CTGTTGGGAA GGGCGATCGG TGCGGGCCTC
TTCGCTATTA CGCCAGCTGG CGAAAGGGGG ATGTGCTGCA AGGCGATTAA
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AGTGAAT

pgn59A *FIG. 15.*

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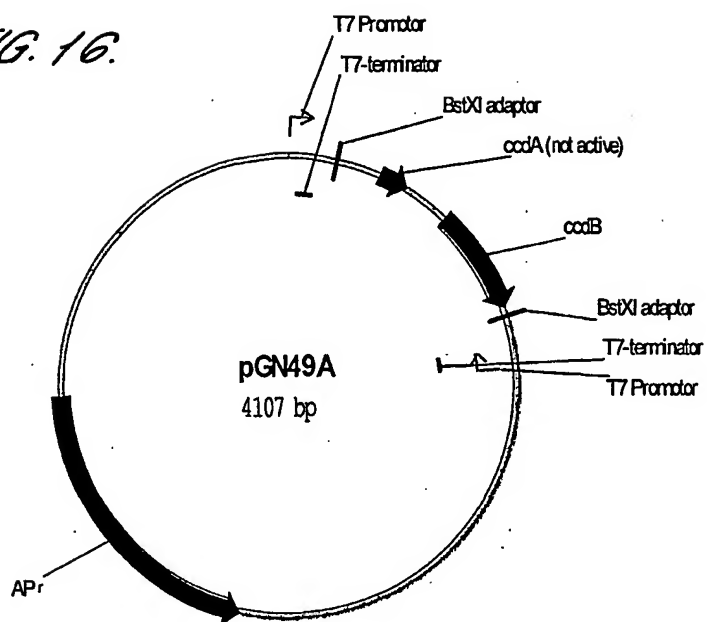
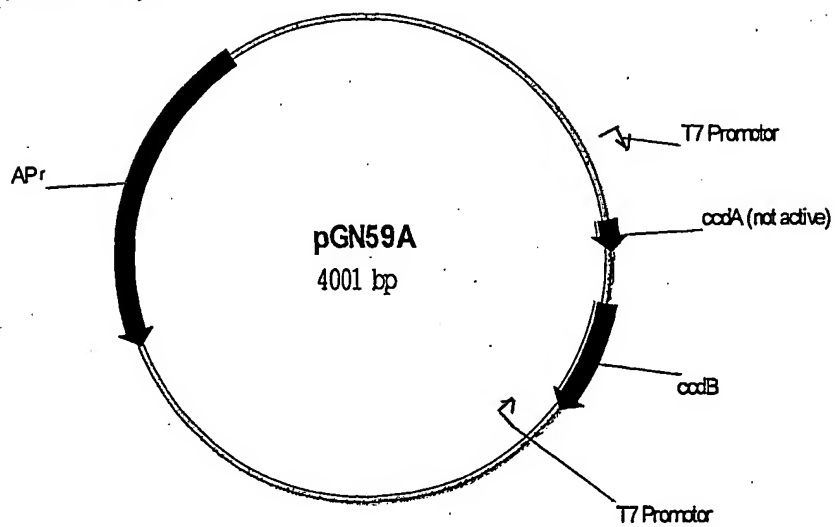
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GGGCGAATTC GAGCTCGGTA CCCGGGGATC CTCTAGAGAT CCCTCGACCT
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CGTCGTCTGC GTGCCGAACG CTGGAAAGCG GAAAATCAGG AAGGGATGGC
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GGGACTGGTG AAATGCAGTT TAAGGTTTAC ACCTATAAAA GAGAGAGCCG
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GATGACCACC GATATGGCCA GTGTGCCGGT CTCCGTTATC GGGGAAGAAG
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ATGTTCTGGG GAATATAAAT GTCAGGCTCC CTTATACACA GCCTTTCCAG
CACAATGGAT CTCGAGGGAT CTTCCATACC TACCAGTTCT GCGCCTGCAG
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FIG. 15 (CONTINUED)

CATAGCTCAC GCTGTAGGTA TCTCAGTTCG GTGTAGGTCG TTCGCTCCAA
GCTGGGCTGT GTGCACGAAC CCCCCGTTCA GCCCGACCGC TGCGCCTTAT
CCGGTAACTA TCGTCTTGAG TCCAACCCGG TAAGACACGA CTTATCGCCA
CTGGCAGCAG CCACTGGTAA CAGGATTAGC AGAGCGAGGT ATGTAGGCGG
TGCTACAGAG TTCTTGAAGT GGTGGCCTAA CTACGGCTAC ACTAGAAGGA
CAGTATTTGG TATCTGCGCT CTGCTGAAGC CAGTTACCTT CGGAAAAAGA
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AAACTTGGTC TGACAGTTAC CAATGCTTAA TCAGTGAGGC ACCTATCTCA
GCGATCTGTC TATTTGTTT ATCCATAGTT GCCTGACTCC CCGTCGTGTA
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TGACATAGCA GAACTTTTAAA AGTGCTCATC ATTGGAAAAC GTTCTTCGGG
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ATTTAGAAAA ATAAACAAAT AGGGGTTCCG CGCACATTTT CCCGAAAAGT
GCCACCTGAC GTCTAAGAAA CCATTATTAT CATGACATTA ACCTATAAAA
ATAGGCGTAT CACGAGGCC TTTCTGCTCG CGCGTTTCGG TGATGACGGT
GAAAACCTCT GACACATGCA GCTCCCGGAG ACGGTCACAG CTTGTCTGTA
AGCGGATGCC GGGAGCAGAC AAGCCCGTCA GGGCGCGTCA GCGGGTGTG
GCGGGTGTG GGGCTGGCTT AACTATGCGG CATCAGAGCA GATTGTACTG

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FIG. 16.*FIG. 17.*

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<130> SCB/55178/001

<140>

<141>

<160> 21

<170> PatentIn Ver. 2.0

<210> 1

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<212> DNA

<213> Artificial Sequence

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<223> Description of Artificial Sequence: Fragment of
pGN1 containing opposable T7 promoters

<400> 1

ttgtaatacg actcactata gggcgaattc gagctcggta cccggggatc ctctagagtc 60
gaaagcttct cgccctatag tgagtcgtat tacagcttga gtattctata gtgtcaccta 120
aatagcttgg cgtaatcatg gtcatactgt tttcctgtgt 160

<210> 2

<211> 49

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: DNA sequence
containing a T7 terminator

<400> 2

actagcataa ccccttgggg cctctaaacg ggtcttgagg gggttttttg 49

<210> 3

<211> 70

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
Oligonucleotide oGN27

<400> 3

aattcaaaaa acccctcaag acccgtttag aggccccaag gggttatgct agtgaattct 60
gcagcgggtac 70

<210> 4

<211> 62

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:

Oligonucleotide oGN28

<400> 4
cgctgcagaa ttcactagca taacccttg gggcctctaa acgggtcttg aggggttttt 60
tg 62

<210> 5
<211> 65
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
Oligonucleotide oGN29

<400> 5
ctagacgcgt aagcttacta gcataacccc ttggggcctc taaacgggctc ttgaggggtt 60
ttttg 65

<210> 6
<211> 65
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
Oligonucleotide oGN30

<400> 6
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cgcg 65

<210> 7
<211> 230
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Fragment of
plasmid pGN9 containing opposable T7 promoters and
T7 transcription terminators

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<210> 8
<211> 3323
<212> DNA
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<220>
<223> Description of Artificial Sequence: Plasmid pGN9

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<211> 3774

<212> DNA

<213> Artificial Sequence

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<223> Description of Artificial Sequence: Plasmid pGN29

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<211> 5148

<212> DNA

<213> Artificial Sequence

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<211> 3715

<212> DNA

<213> Artificial Sequence

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<223> Description of Artificial Sequence: Plasmid
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<400> 11

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<211> 4107

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Plasmid pGN49A

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<210> 13

<211> 4001

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Plasmid pGN59A

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<212> DNA

<213> Artificial Sequence

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<223> Description of Artificial Sequence:
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36

<210> 15

<211> 34

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
Oligonucleotide oGN104

<400> 15

taccaaggct agcatgggccc tgcctgaagg ctgc

34

<210> 16

<211> 40

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:
Oligonucleotide oGN126

<400> 16

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<210> 17

<211> 46
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
Oligonucleotide oGN127

<400> 17
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<210> 18
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<212> DNA
<213> Artificial Sequence

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<223> Description of Artificial Sequence:
Oligonucleotide oGN128

<400> 18
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<210> 19
<211> 37
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:
Oligonucleotide oGN129

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<210> 20
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<213> Artificial Sequence

<220>
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generated by primers oGN103 and oGN104 on pCDM8

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<210> 21
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<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: PCR fragment

<400> 21

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tatggccagt gtgccggtct cgttatcgg ggaagaagtg gctgatctca gccaccgcga 600
aatgacatc aaaaacgcca ttaacctgat gttctgggga atataaatgt caggctccct 660
tatacacagc                                     670
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INTERNATIONAL SEARCH REPORT

International Application No

PCT/IB 01/01068

A. CLASSIFICATION OF SUBJECT MATTER IPC 7 C12N15/10 C12N15/63 C12N15/70 C12N1/21		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC 7 C12N		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the International search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data, BIOSIS, CHEM ABS Data, MEDLINE		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 782 325 A (PROTEUS) 18 February 2000 (2000-02-18) page 7, line 20 -page 8, line 8 page 11, line 11 - line 36 page 23, line 31 -page 24, line 9 ---	1-24, 26, 27
A	WO 00 01846 A (DEVGEN N.V.) 13 January 2000 (2000-01-13) cited in the application page 8, line 9 -page 10, line 22 page 15, line 9 - line 33 page 21, line 21 -page 22, line 29 --- -/--	1-28
<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.		
* Special categories of cited documents : *A* document defining the general state of the art which is not considered to be of particular relevance *E* earlier document but published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. *&* document member of the same patent family		
Date of the actual completion of the international search 20 September 2001		Date of mailing of the international search report 27/09/2001
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer Montero Lopez, B

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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